

RADIO & TELEVISION NEWS

MARCH
1950
35¢
In Canada 40¢

BEHIND THE SCENES
at a
TELEVISION SHOW

PAGE 41

THE QUALITY OF RCA TUBES IS UNQUESTIONED



ANOTHER MILESTONE IN

Television Progress

...the new RCA-16GP4 short
metal-cone kinescope with
"Filterglass" face plate

UNCEASING RESEARCH in television tubes by RCA engineers is responsible for the development of the new, short 16GP4 metal kinescope.

This 16-inch-diameter tube is actually $\frac{1}{16}$ " shorter than the 10BP4 . . . nearly 5" shorter than the 16AP4. Thus, greater flexibility and compactness is made possible in receiver and cabinet design.

Also, a superior picture is realized from the RCA "Filterglass" face plate. Picture contrast is improved by minimizing the effects of reflected room light, and of light reflections within the face plate itself.

RCA's engineering leadership adds *value beyond price* to the RCA tubes you sell. And you benefit directly from this *continued* research by the new enterprises which it creates.

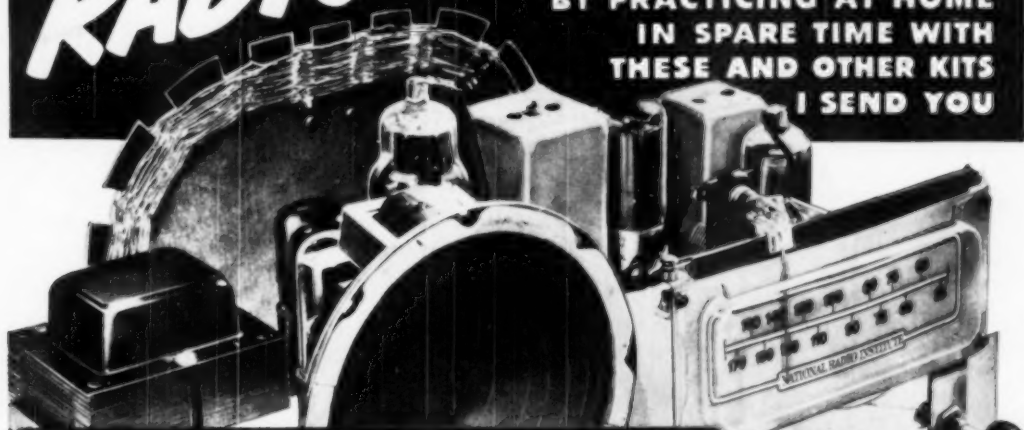
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ELECTRON TUBES HARRISON, N. J.

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J. E. SMITH, President
National Radio Institute

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"Work only spare time at Radio and average about \$40 a month. Knew nothing about Radio before enrolling with N. R. I."—Samuel T. DeWald, St. Clair, Pa.

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men. The man who prepares now will reap rich rewards;

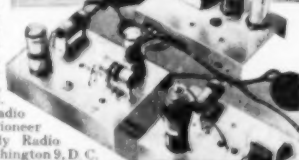
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March, 1950

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RADIO & TELEVISION NEWS



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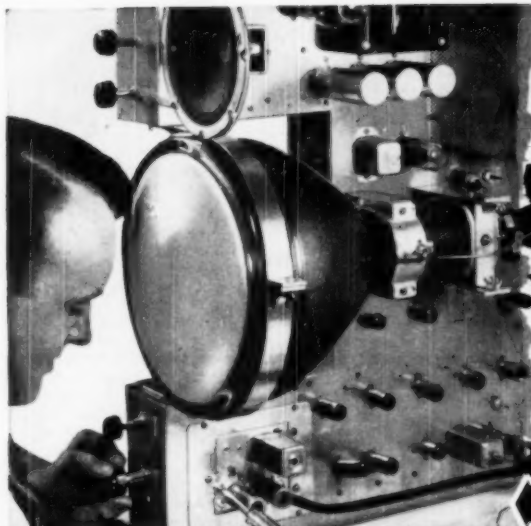
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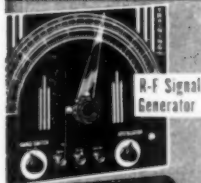
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For the RECORD.

BY THE EDITOR

TELEVISION CAN KILL YOU

IT IS generally known that in our homes are several potential instruments of death. These include such items as our electrical lighting systems, an oil lamp, gas stoves and burners, and even a stepladder.

These items are not dangerous when properly used and they have been with us so long that we know their limitations. The introduction of power tubes in our modern radio sets, with increased voltages, presented a new hazard to the uninformed; however we now use caution in the handling of these circuits and components.

Now we have another problem—and one dangerous to the layman if he is not duly warned. It is the television picture tube. We are all familiar with the quite violent implosion (a bursting inwards) of an ordinary electric light bulb or radio tube—but very few users of television sets have ever witnessed the violent and disastrous effects from a large television tube that has let go.

The trend toward bigger and bigger picture tubes has increased the danger of implosion, flying glass, and potential injury and severe shock from high voltage. Most technicians have been duly warned by manufacturers, in lectures, and by releases from RMA. These men in general handle picture tubes with respect but some, and we have seen them, are very careless and scoff at any advice on the matter of safety precautions. These television tubes are not dangerous if handled properly. If they are handled carelessly, scratched, or dropped, they can very well become an instrument of severe injury or even death.

For those technicians handling such tubes for the first time let them heed the advice of the Cathode-Ray Committee of RMA: don't expose picture tubes until you are ready to use them, wear goggles, keep bystanders away when replacing tubes, remove old tube within carton from premises, and never leave a picture tube in the hands of a customer.

It is also important that the face of the tube, when exposed, be placed on a clean soft padding whenever necessary to set it down. Dispose of the used tubes either by: (a) placing the old tube in a shipping carton properly sealed and then drive a crowbar or similar instrument through the closed top of the container, or (b) dispose of the tube in a metal ash can with a plunger operated through the closed top, and finally, don't use regular picture tubes for display purposes.

The popularity of television kits has

presented an opportunity for experimenters to build their own sets with a consequent reduction in cost. These people should be especially careful in the manner in which they handle exposed units. Testing of high voltage is another source of danger and we have seen several individuals remove the anode cap to test for an arc in order to determine whether or not high voltage was present. Very few home builders are equipped with television test instruments and for that reason rely on make-shift methods.

As far as television customers are concerned, there are always a certain number who are willing to "diddle" with their sets when a service technician is not available. This is a most dangerous practice, especially where children are present and are watching the proceedings. It is the responsibility of both the dealer and the technician to duly warn each and every customer against the hazards that exist on the inside of their TV cabinets. This can be done tactfully and in such a manner as not to cause alarm which would, of course, discourage sales, especially those where a demonstrator is being installed on trial.

The public always needs a lot of education on things electronic. Just as in the case of the amateur radio operator when television set users were damning them for every streak or blemish that appeared on their screens, so have they blamed service technicians for a host of other bad operating conditions. In the case of an accident resulting from the contents of a television chassis, the service technician would also be blamed. All handlers of electronic equipment must, for their own protection, help to educate the public on the correct use of things electronic—particularly television.

As mentioned, the ordinary electric light bulb, when dropped, is capable of producing flying glass over quite a wide area. This implosion would be multiplied many times in the case of a similar breakage of a large television picture tube. The above may serve as an example when explaining the possible danger to the customer. It would take little imagination to foresee what might happen. If a few "case histories" of accidents, resulting from implosion of television picture tubes, appeared in local newspapers it would do much to discourage the advancement of television. Let's exercise every possible precaution so that it won't happen. . . . O.R.

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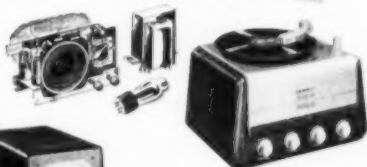
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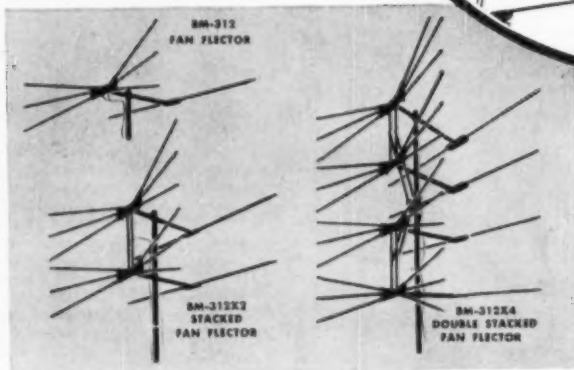
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RADIO & TELEVISION NEWS



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RADIO & TELEVISION NEWS

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All adjustments on the front—easy to get at. Volume off and on—Brightness—Contrast—plus new continuous Tuner

NEW CONTINUOUS TUNER GIVES PRECISE PICTURE CLARIFICATION

Hairline-sharp, fingertip picture adjustment (synchronized with sound) as simple and easy as tuning a radio.

PRE-FIXED, ULTRA SHARP FOCUS

Centers picture—locks in "Sharp Focus" position.

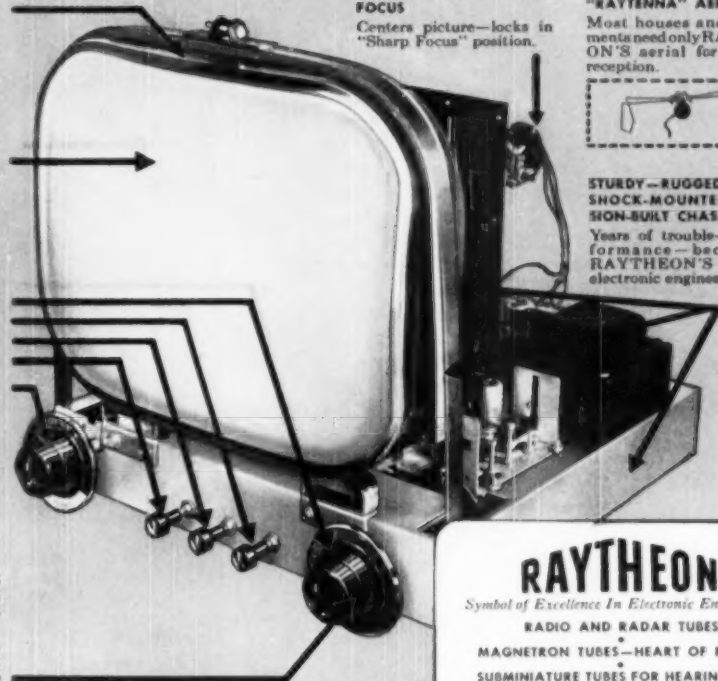
ADJUSTABLE BUILT-IN "RAYTENNA" AERIAL

Most houses and apartments need only RAYTHEON'S aerial for perfect reception.



STURDY—RUGGED RUBBER SHOCK-MOUNTED PRECISION-BUILT CHASSIS

Years of trouble-free performance—because of RAYTHEON'S superior electronic engineering.



SALES APPEAL *inside and out!*

CHOICE OF DESIGN—Modern contemporary in table models, tasteful conservative in floor models.

QUALITY FINISH—Dark, rich mahogany or blonde finishes.

CONTEMPORARY STYLE—Each cabinet is styled to blend with any setting.

MINIMUM SERVICE REQUIREMENTS—RAYTHEON sets are precision-built—not "assembly jobs."

The Silver Anniversary
138 Sq. In. Picture



RAYTHEON

Symbol of Excellence In Electronic Engineering

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SUBMINIATURE TUBES FOR HEARING AIDS

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MICROWAVE RELAY SYSTEMS FOR T. V. F. M. FACSIMILE

F. M. A. M. T. V. TRANSMITTING EQUIPMENT

2-WAY MOBILE RADIO EQUIPMENT

DIATHERMY TUBES

SONIC OSCILLATORS FOR PROCESSING FOODS, DRUGS, COSMETICS

RADIO PHONOGRAPHS—RECORD CHANGERS

ELECTRONIC PHOTO-FLASH EQUIPMENT

ELECTRONIC WELDING DEVICES

DIELECTRIC HEATING MACHINES

20/20 TELEVISION RECEIVERS

RADIO TRANSFORMERS

*Reg. U.S. Pat. Off.

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BELMONT RADIO CORPORATION

Subsidiary of Raytheon Manufacturing Corp.

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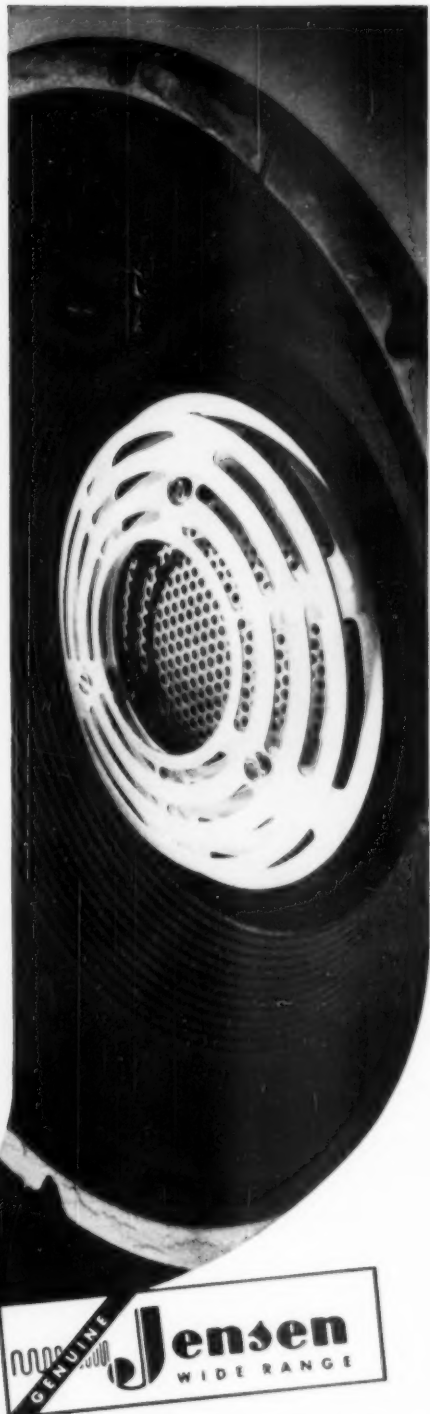
**The FAMOUS GENUINE
JENSEN MODEL 510
COAXIAL SPEAKER**

BEST AT ANY PRICE - - -

Comparative tests with the most expensive types of two-way speakers will prove that the Jensen Model 510 is the best regardless of price.

The new, wide-angle acoustic lens of the "510" is an example of Jensen leadership in loudspeaker engineering. By adapting optical principles to acoustics, this lens acts in conjunction with the h-f horn to distribute h-f radiation uniformly over a wide angle. This insures constant balance and high quality reproduction throughout the whole room.

Whether the "510" is used for broadcast monitoring, professional sound reproduction, or for home entertainment systems, the advanced Jensen electroacoustic design assures the finest performance.



JENSEN MANUFACTURING COMPANY

DIVISION OF THE MUTER COMPANY

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RADIO & TELEVISION NEWS

a new star in the
TELEVISION
 sky...



SANGAMO

6000 VOLT TYPE 13

PAPER CAPACITORS

Here it is! A Television capacitor with a new standard of permanence. Designed to withstand continuous operation at 85°C—no wax—special polyester end seals will not crack or pull away from varnished cardboard tube—this means—capacity sealed in—moisture sealed out. Polyester end seals also provide an excellent insulator for high voltage

applications. Mineral oil impregnation provides longer life and more stable performance over a wide range of operating temperatures.

Critical users are finding the Sangamo 6000 volt Type 13 the answer to paper tubular problems—a television capacitor that fits your needs. See your jobber—If he can't supply you, write us.



SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

In Canada: Sangamo Electric Company Limited, Leaside, Ont.

March, 1950

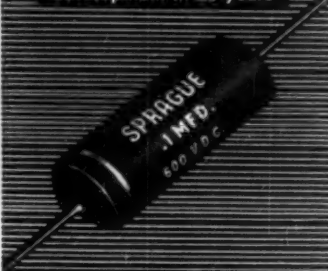
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SPRAGUE

Molded
TELECAPS*

The greatest paper tubular
development in 20 years

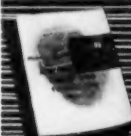


**...premium quality
...plus performance
AT NO EXTRA
COST!**

You really get your money's worth in Sprague high-temperature phenolic molded Telecap tubular capacitors. They're the *only* molded tubulars made by the dry process—then impregnated* and solder-sealed just like expensive metal-encased oil-paper capacitors. They're tops on ANY job—yet you buy them at ordinary tubular prices.

*Mineral oil impregnated from 600 to 10,000 volts d-c.

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Get the better,
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"YOUR MONEY'S WORTH IN
GOOD RADIO AND TELEVI-
SION SERVICE" and details on
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★ Presenting latest information on the Radio Industry

By RADIO & TELEVISION NEWS
WASHINGTON EDITOR

TV, with its color wheels, reflective optics, dichroic mirrors, triple-beam tubes, and field-sequential, line-sequential and dot-sequential red, blue and green systems, transformed Washington and New York into a tense proving ground as the early days of '50 rolled around. With transmitters in the nation's capital and New York City colorcasting on quite an extensive schedule and with specially-built color receivers in strategic locations and under observation by both a technical and man-on-the-street type audience, an all-out polling effort began to race along, viewers being asked to offer opinions which might guide the Commission as they pondered what to do about the blistering problem of color TV.

Activities in the hue quiz centered around Washington during the early days of the trial, with the FCC Commissioners as the pace setters. CBS felt that the gentlemen who will eventually say *yes* or *no* to the color idea should have receivers as soon as the test programs went on the air, and thus models were dispatched to six of the officials who were agreeable to the look-in plan: Wayne Coy (chairman of the Commission), Rosel H. Hyde, Robert F. Jones, George E. Sterling, Paul A. Walker, and Edward M. Webster.

Installation in the government expert's homes was followed by a setup of some fifteen models in a building in downtown Washington, where the public could look in on programs coming from WOIC. Admissions to the showings were provided by complimentary tickets available at such points as a cigar counter at the Mayflower Hotel, assistant manager's desk at the Statler Hotel, desk and newsstand at the Willard Hotel, front desk and newsstand at the Carlton Hotel, main floor desk of the *Washington Post* and the Walker building, where the sets were located, and two stations, WOIC and WTOP. Those attending the public viewings were asked to cite what they thought about the quality, detail, and general picture impression.

In New York, the tests of a more technical nature and conducted in one of the CBS studio buildings, involved a small group of viewers, looking in on 10-inch screen models equipped

with magnifiers providing a 12-inch picture. In Washington, three types of receivers were provided, with 7-inch, 10-inch, and 16-inch basic picture tubes. The 7- and 10-inch images were magnified to 10- and 12-inch sizes, while the 16-inch tube had a mask to reduce the image to about 13 inches and a magnifier to bring the picture back to about 16 inches. The smaller models were featured in the public-viewing arrangements in the Walker building.

The information sought from the New York groups concerned such problems as co-channel interference. With a push-button at the viewer's disposal to vote on the acceptability of the picture as varying degrees of co-channel venetian-blind effects were introduced, CBS hoped to compile a report on station spacing for both color and monochrome allocations. WOR-TV, cooperated in the test, supplying a signal which was converted by CBS into co-channel type of input.

The RCA public tests, which hadn't begun as this column was being prepared, were expected to follow the CBS pattern. Technical tests were, however, under way, with the FCC's Laurel laboratories and the Condon Committee, which is conducting an investigation for the Senate Interstate and Foreign Committee, scheduled to receive direct-viewing 10-inch models.

Commenting on RCA's color experiences, in a report to the FCC, E. W. Engstrom said that from September 18 to December 30, 1949, a total of 409 hours of test operation on the air were provided by WNBW and KG2XCL, the former using standard channel 4 and the latter an experimental frequency in the 523 to 529 mc. band.

The usefulness of the public-poll information, based on the one-system viewing, appeared to be of little long-term value, according to many observers. They declared that unless it becomes possible to view the systems in a comparative way, the expressions offered can mean little. Answers to such important questions as color values and eye comfort cannot be provided very readily by the average person, these experts added.

When the consensus information is compiled, it may contain the testimony of one viewer who didn't have

RADIO & TELEVISION NEWS

For the **MOST** in Television Reception



THE SKY HAWK

TELE-ROTOR

For Clear Sharp Pictures and
Perfect Trouble-Free Performance

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TELE-ROTOR
CONTROL

with the "Perfect Pattern" Dial
... Gives Immediate Indication
of Antenna Position.



IT'S
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A Triumph in Design!!! There's
Nothing Like It... It's Beyond Compare!

CHECK THESE FEATURES

- Handles Heavier Loads With Ease ... As Much As 150 Pounds
- Streamlined Weather-proof Design ... Durable Sturdy Construction
- 13 Heavy-Duty Ball Bearings in two 6 1/2" diameter Ball Bearing Races
- Heavily Reinforced Die-Cast Housing
- Heavy-Duty Precision Gears
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- Will Handle 7/8" to 2" diameter Upper and Lower Masts Instantly
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- Mast, Tower or Platform
- Four Heavy-Duty Guy-Wire Lugs
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- ... Factory Lubricated For Life

The television industry has been looking for something like this ... and it took CORNELL-DUBILIER to produce it! THIS is the last word in ROTATORS ... the finest! ... BECAUSE IT HAS EVERYTHING! It wasn't developed overnight but is the result of fourteen solid months of research and development! BUT ... it has been worth it! ... BECAUSE IT MEASURES UP TO CORNELL-DUBILIER STANDARDS.

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a CBS model, but rather one that was built in a shop at home. Forrest W. Killy of Roselle, N. J., reported the color pickup news, declaring that he was able to tune in on the colorcasts by making some minor changes in his set. He accomplished this, he said, by first installing a switch to control the horizontal oscillator of his model. Turning this switch on reduced the number of lines in the picture from 525, the black and white standard, to 405, used in color work. Then he took some cardboard, and sheets of red, green and blue cellophane, and constructed a pie-shaped disc about 12 inches in diameter, with alternate layers of the red, green and blue cellophane. The disc was hooked up to a phono motor, whose speed was increased to provide color resolution. The wheel was then placed in front of the picture tube, which he claims provided good color pictures.

Although no official opinions on the color tests were available from FCC quarters, one member of the Commission did reveal in quite an explicit manner just where he stood on the issues. From color TV's staunchest supporter, Commissioner Robert F. Jones, came the expressions, and there were many, appearing before a luncheon meeting of the American Marketing Association at the Hotel Commodore in New York City, the Commissioner fired away at industry, accusing them of delaying color TV. He said that too many manufacturers had spent little or nothing on color research of their own or field testing of systems proposed by others.

"Instead of offering us the results of field tests," he went on, "we are offered new forms of advisory committees, committees which are but a part of a general scheme which frequently reminds me of the interlocking directorates the public utilities used in the heyday of that industry."

The Commissioner pointed out that in 1941, the National Television Systems Committee showed great interest in color, suggesting that the art should be encouraged and field tested at once. Unfortunately, he added, the war intervened with the steps that were to be taken in advancing color. But since the war's end, the FCC official continued, there has been ample opportunity to continue in the enthusiastic spirit shown eight years ago.

The Commissioner also directed his anger at industry in a letter to Paramount Television Productions' president, Paul Raibourn, declaring that the prexy had displayed a "debonaire" attitude toward the art and a "lack of work or at least enthusiasm" for the color systems. The letter was in reply to one from Raibourn which had commented on Jones' questioning during the hearings concerning the absence of the motion-picture executive. The prexy indicated that he would be very pleased to appear and offer his opinions, and had not appeared earlier since he had no new engineering data to offer. The Commissioner noted in

his letter that he hoped that when Raibourn appeared he would not... "join the parade" of the many who oppose... "anyone who dares to have a different view than the vested interests."

THE ANNUAL DINNER of the Federal Communications Bar Association in Washington was the scene of another sharp report on color, with color enthusiast Senator Edwin Johnson providing the views. According to the Senator, an FCC decision in favor of color TV standardization will be made and the Condon Committee's report, soon to appear, will... "fortify and bolster the Commission's decision that we are ready for color television now." The Senator added that... "Since it is generally agreed that color is practical, most emphatically the public interest would not be served by waiting until thirty million families have invested upward of six billion dollars in black and white sets, before switching to color."

In reply to the blunt words from Washington, industry announced the formation of a new National Television System Committee to help attain industry-wide agreement on technical developments needed for the expansion of television to all sections of the country and for the establishment of basic standards which will bring color television to reality.

Reporting on the formation of the committee, RMA Prexy Raymond C. Cosgrove said: "While color television is not yet ready for commercial application, laboratory development has progressed to a point where pooling of information and concerted action from all sources is essential to creation of standards which will eventually bring it out of the laboratory and controlled broadcast stage and into the home."

"Television manufacturers are eager to present color to the public just as soon as research and field testing have made it practical for broadcasting and home use, but not before," Cosgrove added.

"In the meantime, it is believed that the National Television System Committee will be able to assemble the data necessary to letting all sections of the country enjoy the benefits of television, and not just selected areas," the RMA headman concluded.

Guiding the new committee will be Dr. W. R. G. Baker, who was chairman of the 1941 systems group which drafted and recommended the FCC standards upon which black and white TV has been built. Assisting him will be Don Fink and David B. Smith, serving as vice-chairmen.

According to present plans, the committee will cooperate closely with the FCC during the allocation hearings and will submit regular reports to the Commission, in addition to serving as advisors for the study of special problems.

The NTSC of '50 should be the answer
(Continued on page 125)

RADIO & TELEVISION NEWS

YOU Need My PRACTICAL Training to Make Money in



I'll Send You
8 BIG KITS of
Radio Parts and Equipment

Learn at
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IN YOUR
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TELEVISION

RADIO and ELECTRONICS!

NOW IS THE TIME To Get Into This Fast Growing Industry—Prepare For A Fine Paying Job Or Your Own Business!

If you want to get into Radio-Television and Electronics... you owe it to yourself to get the facts about my training. I have trained hundreds of men to become outstanding service technicians—and I'm ready to do the same for you. Whether your goal is a fine paying job in one of Radio's many branches—or a successful Radio and Television business of your own—you need the kind of training I offer! My training is practical and down to earth. **YOU NEED NO PREVIOUS EXPERIENCE.** You'll be astonished at your rapid progress. I start you with basic fundamentals and give you plenty of practical shop-bench training with many kits of parts I send you. This is the training that sticks with you and makes money for you on the job!



Get Paid For Spare Time While Learning

Soon after you start training I send you my famous **BUSINESS BUILDERS** that show you how to make money in spare time doing interesting Radio jobs. Look at the useful and valuable equipment you get while training with me (illustrated at left)—I send you these 8 big kits of Radio parts and equipment and help you build step-by-step a powerful 6-tube superhet radio, a 16-range test meter, plus other mighty useful equipment for Radio and Television servicing. You will perform over 175 fascinating experiments while training. You will learn about Television—so that you will be qualified to step into this fast growing, profitable field. I also send you many valuable service manuals, diagrams and my book telling exactly how to set up your own Television and Radio shop. *I want you to learn all about my training*—and that is why I urge you to clip and mail the coupon below for my two big **FREE** Radio books. I employ no salesmen—and nobody will call on you. The important thing is to get now and get the facts.



HAVE A BUSINESS OF YOUR OWN

A profitable Radio and Television Service Shop may be started with little capital. I will show you how to get started and how to build your small business. At left is pictured one of my graduates, Mr. Merrit C. Sperry of Fairmont, Minnesota in his own shop. The way is also open for you to build a good **SERVICE BUSINESS FOR YOURSELF.**

ALL KITS ARE YOURS TO KEEP

Each of the hundreds of Radio parts and other items I send my students is theirs "for keeps." You may use this equipment in your Radio and Television service work and save many dollars by not having to buy expensive "ready-made" test equipment. Each of my 8 kits will help you advance and learn important steps in Radio and Television servicing.



CALVIN SKINNER of New Orleans, La. tells us he makes \$5 to \$10 in spare time repairing radios. He is now also working with his own Television set.



LOREN D. SAUCIER of Columbia, Mich. reports that my training has made it possible for him to repair large numbers of Radio and Television receivers.

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You couldn't pick a better time to get into Radio-Television and Electronics. New Television stations are going on the air to serve every major city—hundreds of new AM and FM Radio broadcasting stations are also on the air to serve practically every community in America. All this creates new and bigger opportunities for the trained man who knows Radio-Television and Electronics. Good Radio and Television service men are needed NOW!

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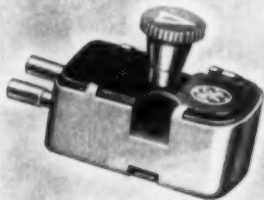
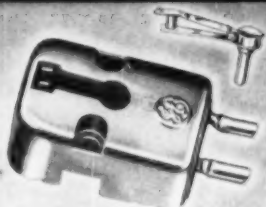
VARIABLE RELUCTANCE CARTRIDGES

★ FOR QUALITY ★ FOR PRICE ★ FOR TURNOVER

Compare These General Electric Variable Reluctance Cartridges With Anything On The Market!

NEW "BATON" STYLUS ➔

provides unexcelled delicacy of tone for critical ears. Dual-twist stylus assembly (inset) permits higher lateral compliance and improved tracking. Double damping blocks filter out needle talk and mechanical resonance. This new assembly now included in all types of G-E Cartridges. RPX-040 and RPX-041.



← TRIPLE PLAY CARTRIDGE

Ride the sales boom of this sensational new G-E model! Plays all three types of records without a change of position in the tone arm! A flick of the knob selects stylus. Requires no adjustment of tone arm weight. Costs 25% less than the 2 cartridges it replaces! A hit with manufacturers and listeners alike! Model RPX-050.

PROFESSIONAL VARIABLE ➔ RELUCTANCE CARTRIDGE—

One of the most popular cartridges of the G-E Line. Preferred by broadcast station engineers for its smooth, wide-range frequency response designed to match broadcast equalizers. Operates with any G-E stylus. Model RPX-046.



You can't beat these General Electric Variable Reluctance Cartridges for superb reproduction, sturdy construction, and low cost. That's why manufacturers, radio stations and the listening public everywhere continue to select the G-E Cartridge that fits their needs best.

You can get a bigger share of the valuable replacement business by stocking the models shown here. Don't delay—place your orders today!

PLENTY OF PROMOTION!

Ask your distributor for complete 1950 G-E Parts Promotion Kit! Counter displays, ad reprints, full line sheets and folders, everything you need to sell more G-E speakers, cartridges, parts and accessories! Get it today!



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Send me latest information on stylus wear plus FREE folder on the new G-E Baton stylus.

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You can put your confidence in—

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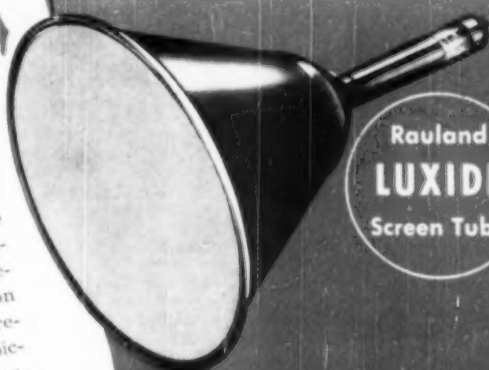
..sell **RAULAND** replacements!

Here are the two greatest improvements in picture tubes since the war—both available from Rauland for your replacement business. Leading jobbers and dealers prefer and rec-

ommend them because they actually give customers better pictures than when their sets were new—assuring customer satisfaction that pays off in extra profits.

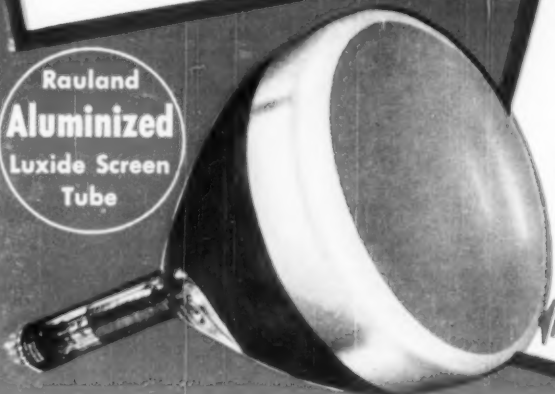
Rauland Luxide Screen Tubes

The public is clamoring for new Television sets featuring this new Rauland-developed tube. Now the Luxide Screen is available for replacement use in two tube types—metal-coned 16AP4-A, and all-glass 12LP4-A. The face of this new "black" tube contains a metallic oxide which gives the glass desirable light-absorbing characteristics. Both the reflection of ambient light and halation within the tube face are materially reduced. The result is a sharp, clear picture with such greatly increased contrast and clarity that it can be viewed in lighted rooms without "washing out" and without annoying glare.



Rauland
LUXIDE
Screen Tube

Rauland
Aluminized
Luxide Screen
Tube



Rauland Aluminized Luxide Screen Tube

This Rauland-developed replacement tube has brought thousands of owners clearer, brighter pictures than they enjoyed before. The Rauland aluminized screen gives pictures up to 80% brighter than conventional tubes—with better contrast and sharper definition. The Rauland aluminized tube does not require any ion trap magnet—the adjustment of which, on ordinary tubes, is critical and if improperly made, will result in damaging the tube. The Luxide Screen feature is now available in the aluminized tube as type 12KP4-A.

THE RAULAND CORPORATION



Perfection Through Research

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the New PYRAMID "Humidi-Seal"

(TUBULAR PAPER CAPACITOR)



Ruggedly built to withstand undue vibration and rough handling

Outer tube plastic impregnated to prevent moisture absorption

Light outer coat of high temp wax provides double protection

Each end plastic sealed against moisture

Leads anchored securely in solid plastic end

Type 85TOC "Humidi-Seal" capacitors are specially designed for 85° C. operation, even in the most humid atmospheres, and will meet the severe present day demands of endurance in television receivers, auto radios, etc.

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CABLE ADDRESS: Pyramidusa

Within the INDUSTRY

ALFRED C. VIEBRANZ is the new general sales manager of the Electronics Division of *Sylvania Electric Products Inc.*, succeeding **George C. Conner** who is GSM of the Photoflash Division.

Mr. Viebranz was formerly government sales representative for the Electronics Division at Washington. He joined the *Sylvania* staff as sales engineer in 1946 and during the war served as a lieutenant, USNR in submarine service.

He holds a B.S. in Physics from St. Lawrence University and later took graduate work at the U. S. Naval Academy and was graduated as a communications engineer. He is a member of the IRE, the Radio Technical Commission for Marine Services, and the Radio Technical Commission for Aeronautics.

AMERICAN STRUCTURAL PRODUCTS COMPANY, a subsidiary of *Owens-Illinois Glass Company*, has announced that seventy-five per-cent of its television bulb production capacity will be devoted to the new all-glass rectangular bulb.

The increased production rate for the new all-glass rectangular bulb has been necessitated by the increased demand for this type of television tube. Approximately 33 per-cent of the company's capacity was devoted to production of the 16 inch tube during January and 50 per-cent devoted to 14 and 16 inch production in February.

The company developed and introduced the rectangular bulb late in 1949.

J. J. CLANCY of Fort Wayne, Indiana has been named sales representative of the northeastern Indiana and southern Michigan territory for *Webster Electric Company*. He recently took over representation of the *Radio Merchandise Sales, Inc.* line in Michigan while continuing to serve R.M.S. customers in Ohio, Indiana, and Kentucky. . . . **ALLEGHENY HOME APPLIANCE COMPANY** of Huntington, West Virginia will handle the *Du Mont* line in the Huntington and Charleston areas. . . . **W. BERT KNIGHT CO.** has been named manufacturer's representatives for *The House of Television, Inc.*, New York. Working out of Los Angeles, the *Knigh* outfit will cover southern California and Arizona. . . . *Raytheon Manufacturing Company*

has appointed **LAY AND NORD** of Yakima, Washington and **TROJAN RADIO COMPANY** of Troy, New York as distributors for the company's line of receiving, television, and special purpose tubes. . . . **SOUTHWEST DISTRIBUTING COMPANY** has been appointed distributor of *Stewart-Warner Corporation's* radio and television products in the Kansas City territory. . . . **WALLACE SCHNITZER** has joined the *Gerald B. Miller Co.* of Hollywood as an engineer in the company's industrial instrument division. . . . **Jobbers** in Ohio, western Pennsylvania, West Virginia, and eastern Kentucky will have **J. R. DANNE MILLER ASSOCIATES** as their new jobber representatives for the *Utah, Inc.* line. . . . *John Meck Industries, Inc.* has named **TURNQUIST BROTHERS COMPANY** of Los Angeles as franchise distributor for its line of television and radio receivers.

EDWARD A. MALLING has been appointed to the post of sales manager for component parts in the *General Electric Receiver Division* at Syracuse.

He will be responsible for the sale of parts to initial equipment and distribution accounts. This includes the sale of such items as loudspeakers, television receiver components, antennas, phonograph tone arms, and the variable reluctance cartridge.

Mr. Malling has been associated with *General Electric* since 1935 when he joined the Electric Refrigeration Department at Nela Park, Cleveland. Since that time he has served in the Appliance and Merchandise Department and the Electronics Department. He has held several positions in the latter department since being assigned in 1945.

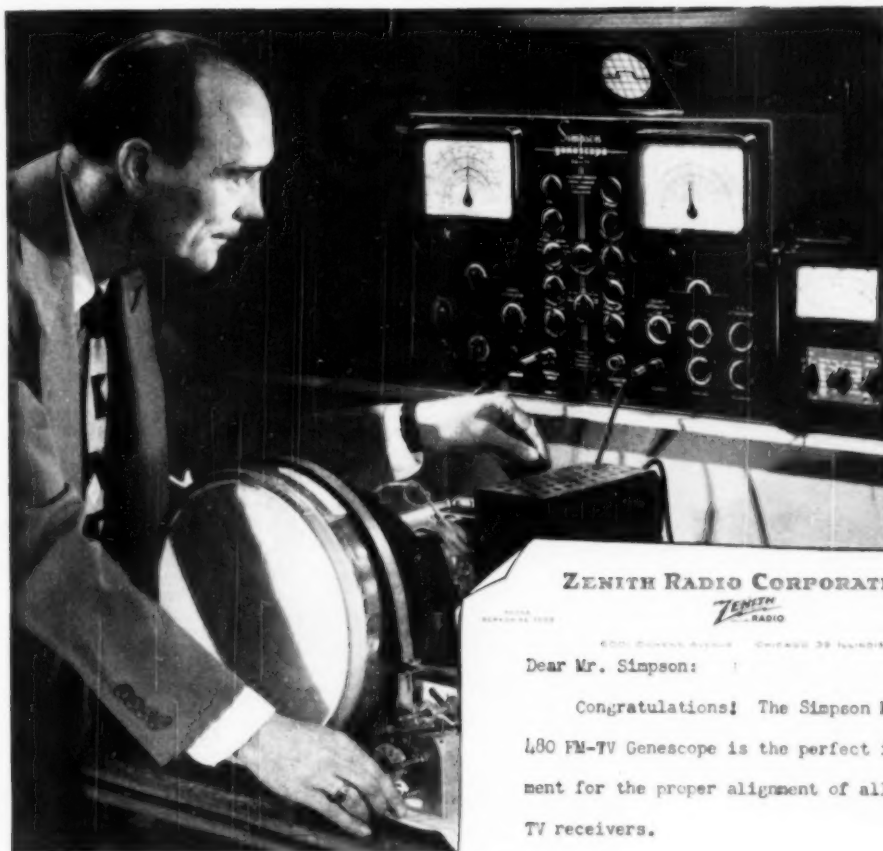
MARTIN L. SCHER has been named general sales manager of *Motorola-New York, Inc.*, New York distributor for *Motorola, Inc.* of Chicago.

Prior to joining *Motorola*, Mr. Scher was for four years general sales manager for *Admiral Corporation's* New York distributing division and for the *Dale Distributing Company*, predecessor to the *Admiral Division*.

During the war he served as sales



RADIO & TELEVISION NEWS



says FRANK SMOLEK,

General Service Manager of Zenith

In addition to providing all necessary signal sources, the new Simpson Genescope includes a high sensitivity oscilloscope of unique advanced design, complete in every detail. Sensitivity 25 millivolts per inch. Wide band response to 3 megacycles or more. Equipped with a high frequency crystal probe for signal tracing. AM and FM oscillator sections provided with large, easy to read dials with 20:1 vernier control and 1000 division logging scale. Revolutionary, ingenious. Exclusive output termination provides for various receiver impedances, either direct or through an isolating condenser.

Step attenuator for control of output.

Size: 22"x14"x7 1/2". Weight 45 lbs. Shipping Weight 54 lbs.

DEALER'S NET PRICE complete with Test Leads and Operator's Manual \$375.00

ZENITH RADIO CORPORATION



Circle 100 on Reader Service Card

6000 Chicago Avenue, CHICAGO 38, ILLINOIS

Dear Mr. Simpson:

Congratulations! The Simpson Model 480 FM-TV Genescope is the perfect instrument for the proper alignment of all FM and TV receivers.

In addition to providing all necessary

CHECK THESE RANGES AND YOU WILL SEE HOW MUCH THE SIMPSON GENESCOPE CAN DO FOR YOU

RANGES FREQUENCY MODULATED OSCILLATOR

Band A—2-120 megacycles
Band B—140-260 megacycles
Sweep width variable from zero to 15 megacycles
Sweep rate 60 cycles per second
Specially designed frequency sweep motor
Continuously variable attenuator
Crystal calibrator—5 megacycles $\pm .05\%$
Audio Oscillator 400 cycles

AMPLITUDE MODULATED OSCILLATOR

Band A—3.2-16 megacycles
Band B—15-75 megacycles
Band C—75-250 megacycles
20% modulation at 400 cycles or unmodulated
Continuously variable attenuator
Visual method of beat frequency indication

Modern FM and TV development and servicing requires the use of test equipment made to exacting standards. With this in mind Simpson offers you the Genescope with the assurance that everything possible has been done to make it the most accurate, flexible and convenient instrument available. The Genescope will render many years of uninterrupted service and always produce accurate results.

HERE'S THE SIMPSON—MODEL 479 TV-FM SIGNAL GENERATOR

Exactly the same circuits, ranges and functions as the Model 480, described above, with the exception of the oscilloscope.

Size 17"x14"x7 1/2". Weight 34 lbs.
Shipping Weight 40 lbs.

DEALER'S NET PRICE with Test Leads and Operator's Manual \$245.00



Simpson
INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPANY

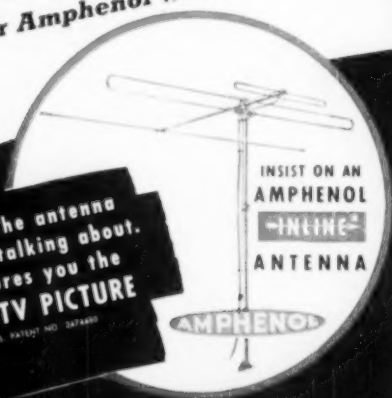
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"We have a much better picture than the neighbors. I think the serviceman was right when he said it's all because of our Amphenol INLINE* Antenna."

This is the antenna they are talking about. It assures you the Best TV PICTURE

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AMERICAN PHENOLIC CORPORATION
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director for the Electronic Research Supply Agency of the RFC where he was in charge of stockpiling critical electronic components.

H. JAMES TAIT was recently appointed Eastern States regional sales manager for the receiver sales division of *Allen B. Du Mont Laboratories, Inc.*

Mr. Tait, who has been with the *Du Mont* organization for some time, has been working out of the New York Regional Sales Office, handling the Bronx-Long Island territory. In his new post, he will head receiver sales activities in the states along the eastern seaboard from Maine to South Carolina.

He will make his headquarters at the company's offices at 515 Madison Avenue, New York City.



RADIO MANUFACTURERS ASSOCIATION, in cooperation with the Institute of Radio Engineers and the American Institute of Electrical Engineers, is sponsoring a "Conference on Improved Quality Electronic Components" to be held in Washington May 9-11. Military and government representatives will confer with the representatives of the industry organizations.

New techniques for producing longer-life components, especially for military, aircraft, and industrial electronic equipment, will be discussed at the symposium to be held in the new Department of Interior auditorium.

The symposium will give emphasis to the following topics: improved quality of circuit elements for greater dependability of electronic equipment, unitized packaging as a means for greater dependability through simplified maintenance, miniaturization, particularly as applied to the unit package, and circuit elements compatible with design requirements of the unit package.

PAUL B. H. SMITH was elected to the post of vice-president and director of *Zenith Radio Corporation of Canada, Ltd.* at a recent meeting of the directors of that company.

The Canadian corporation is a subsidiary of *Zenith Radio Corporation* of Chicago and has headquarters in Windsor, Ontario.

In addition to his new duties, Mr. Smith will continue as general sales manager of the company's hearing aid division, with headquarters in Chicago. Previously, he was manager of the Canadian subsidiary for a two year period. From 1935-1944 he was affiliated with the sales, sales promotion, and public relations departments of the *Ford Motor Company of Canada* in Toronto and Windsor.



CHARLES A. GARDINER has been named treasurer of the *Hudson Wire Company* of Ossining, New York. He joined the company 20 years ago, and has been serving as controller . . . **JAMES M. SCALES** is the new district sales manager for the northwestern territory of *Zenith Radio Corporation* . . . **W. H. SALEE** has taken over the post of general sales manager of *Janette Manufacturing Company*, Chicago manufacturers of rotary converters and gear-motors. He succeeds Harvey Klunder who resigned . . . *General Electric Company* has made three new appointments in the Tube Division. **E. F. PETERSON** has been named manager of sales. **L. B. DAVIS** is the new manager of the receiving tube division at Owensboro, Ky., and **K. C. DEWALT** has been appointed manager of the cathode-ray tube division at Syracuse . . . **JOHN D. SMALL** was elected vice-president of *Emerson Radio and Phonograph Corporation* while **ABRAHAM ROSEN** was promoted from controller to assistant treasurer. **A. A. VOGEL**, assistant controller, takes over Mr. Rosen's former post . . . **HUGO SUNDBERG** has been upped to the post of vice-president and manager of *Oxford Electric Corporation*, Chicago manufacturers of loudspeakers . . . *Gertsch Products, Inc.*

(Continued on page 96)

Sylvania's NEW

Tube Testers

are one jump
ahead of
tomorrow!



MODEL 220

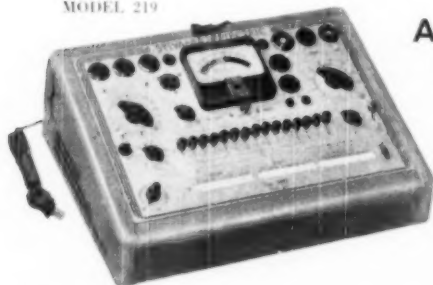
Once again Sylvania has anticipated radio and television developments. Sylvania's new tube testers, both counter and portable models, are not only capable of testing every modern receiving tube . . . they are calibrated to Sylvania's latest tube production standards.

Experts in tube-testing have built this new instrument . . . but you don't have to be an expert to operate it. Counter clerks, uninitiated in radio technicalities, can use it after a few minutes'

instruction. For the benefit of the customer, the illuminated meter reads "GOOD" or "REPLACE" for all tubes, including diodes. Gas tests can be made easily. It is the first tester with both circular and linear subminiature sockets. The new fast, smooth-running roll-chart is easily removable from the front panel.

Modern styling of both models tells even the layman that your up-to-the-minute service is one jump ahead of tomorrow!

MODEL 219



A few more facts on what's NEW

In Tube Testers 219 (Counter) and 220 (Portable)

- Novel voltage controls prevent tube damage
- Switch-numbers correspond to tube pin-numbers
- Switching arranged for easiest operation
- Exclusive ohmmeter-type indicator for shorts and leakage
- Shorted tube reads "REPLACE"—no neon lamp
- Double-size power transformer

NOTE ON "KNOW-HOW"

A comprehensive explanation of tube characteristics and tube tester applications comes free in each Operating Manual.

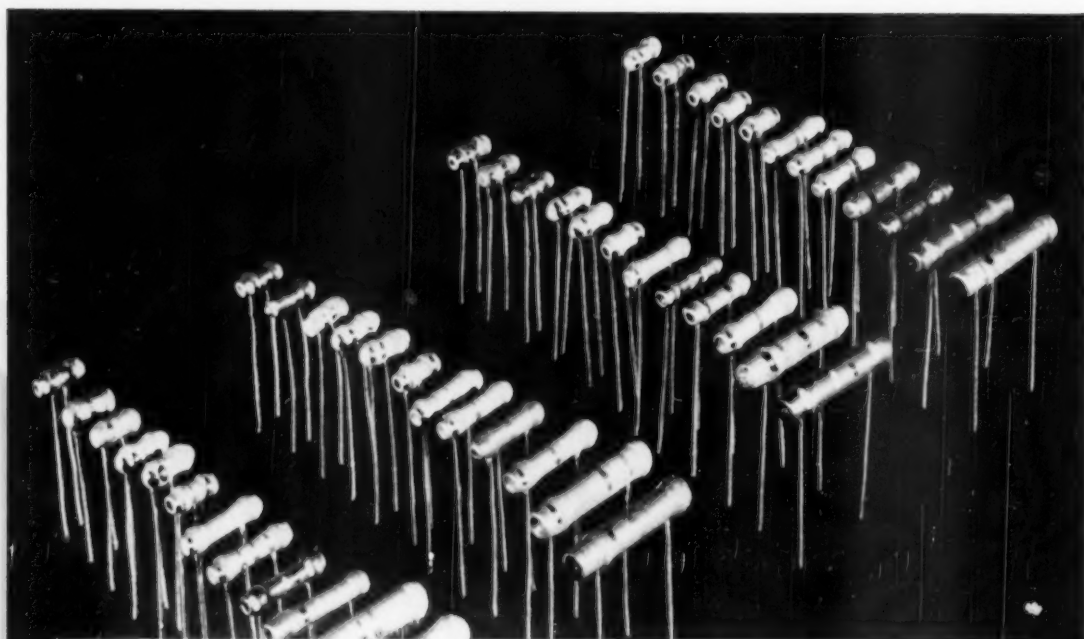
SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS

March, 1950

25

NOW..A NEW, WIDER LINE



Choose from this Complete Ceramic Capacitor Line

Your radio parts distributor can supply you with these BC Hi-KAP Tubular Ceramic By-pass and Coupling Capacitors in the following values — all rated at 600 WVDC, flash tested, 1000 VDC. Packaged in cellophane envelopes, 5 of one value per envelope.

Capacity	CRL Cat. No.	Capacity	CRL Cat. No.	Capacity	CRL Cat. No.
10MMF	D6-100	120MMF	D6-121	1,000MMF	D6-102
12MMF	D6-120	150MMF	D6-151	1,200MMF	D6-122
15MMF	D6-150	180MMF	D6-181	1,500MMF	D6-152
18MMF	D6-180	200MMF	D6-201	1,800MMF	D6-182
20MMF	D6-200	220MMF	D6-221	2,000MMF	D6-202
25MMF	D6-250	250MMF	D6-251	2,200MMF	D6-222
27MMF	D6-270	270MMF	D6-271	2,500MMF	D6-252
33MMF	D6-330	300MMF	D6-301	2,700MMF	D6-272
39MMF	D6-390	330MMF	D6-331	3,000MMF	D6-302
40MMF	D6-400	390MMF	D6-391	3,300MMF	D6-332
47MMF	D6-470	400MMF	D6-401	4,700MMF	D6-472
50MMF	D6-500	470MMF	D6-471	5,000MMF	D6-502
56MMF	D6-560	500MMF	D6-501	5,600MMF	D6-562
68MMF	D6-680	560MMF	D6-561	6,800MMF	D6-682
75MMF	D6-750	680MMF	D6-681	7,500MMF	D6-752
100MMF	D6-101	750MMF	D6-751	10,000MMF	D6-103

For other ceramic capacitor replacement needs, use CENTRALAB's line of TV HI-VO-KAPS, KOLORDISKS and TC capacitors.

OF TUBULAR BC HI-KAPS!

Mr. Service Engineer . . . If your profits and reputation depend on guaranteed repairs, then this message is for You! Centralab . . . the First name in ceramic components . . . gives you famous ceramic tubular BC Hi-Kaps in 48 different and many new values. Check their advantages . . . see why CRL BC Hi-Kaps are absolutely safest for guaranteed repairs.

The present trend to *guaranteed service policies* demands that service engineers take no profit-risking chances with replacement parts of doubtful performance and durability.

Chart below gives you the facts. Read them. See why we say *no other tubular by-pass and coupling capacitors made will outperform or outlast CRL Tubular Ceramic BC Hi-Kaps!*

Centralab

DIVISION OF GLOBE-UNION INC., MILWAUKEE, WIS.

Check these Features . . . See for Yourself why CRL BC Hi-Kaps are "safest"

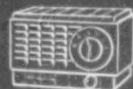
"HI-KAP" FEATURES	DESCRIPTION			WHAT IT MEANS TO YOU
1. Impervious to moisture	Ceramic-X is non-hygroscopic. Moisture absorption is .007% or less.			No deterioration, no shorting. Longer life even under the most adverse conditions of humidity.
2. Low mass weight	AV. WT.	DIMENSIONS	VALUES	For unit size and weight, Centralab BC "Hi-Kaps", made with Ceramic-X, are the only capacitors on the market which provide these voltage ratings.
	.029 oz.	D—.260" L—.530"	10—390 mmf.	
3. Small Size	.044 oz.	D—.260" L—.810"	400—3000 mmf.	
	.050 oz.	D—.280" L—.900"	3300—5000 mmf.	
4. High capacity	.082 oz.	D—.330" L—1.200"	5600—10,000 mmf.	
	Ratings: 600 WVDC — 1000 flash test.			
5. Special insulation	Low power factor resin and high temperature wax coatings, with an additional special phenolic jacket.			Prevents any possibility of shorting to adjacent leads, chassis or components.
6. Convenient side leads	Heavy No. 22 gauge tinned copper, silver soldered to electrodes.			Permit rapid, close-coupled connections. No tricky bending or fitting required.
7. Low power factor	Initial — .6%. After 100 hours, 95% humidity test — 3.0%.			More efficient circuit operation, fewer failures.
8. High leakage resistance	Initial — 5000 megohms. After humidity — 500 megohms.			Long life, more efficient performance.
9. Maximum dependability	Pure silver electrodes, electro-bonded to Ceramic-X dielectric. Protected against oxidation or mechanical damage by coatings of electrolytic copper and solder.			Moisture and puncture proof. Will not short or become intermittent.
10. Factory tested	For your protection, all units 100% factory tested before packaging and shipping.			Your guarantee to your customers of reliable service and performance.



WE'RE STILL IN THE *RADIO* BUSINESS

Seems as though everything nowadays is TV...TV...TV. We've had so much TV news for you! Hytron's new 16RP4 rectangular picture tube. Hytron's new low-cost deflection-circuit tubes: 1x2, 6BQ6GT, 6U4GT, 6W4GT, 25BQ6GT, and 25W4GT. And many more Hytron designed-for-TV tubes coming.

But we're still in the *radio* business — both of us. Radio still is king. We realize that. Also that most service problems are still radio — not TV. You can depend on Hytron *radio* tubes. Whether it is the original Hytron GT...miniature...G...metal...or loctal. For a-c d-c, portable, f-m, phono, or auto radio. Hytron will strive to give you the most dependable *radio* (as well as TV) replacement tubes.



FREE

New Hytron Tool Catalogue. Describes all the famous Hytron service-shop tools to date. Soldering Aid, Tube Lifter, 7-Pin and 9-Pin Straighteners, Tube Tapper, and Auto Radio Tool. Find out how these Hytron tools can ease your work. Mail the coupon today.



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RADIO & TELEVISION NEWS

Unit switch construction houses precision resistors in insulated recesses.

Easy-to-change standard batteries. Double spiral springs give permanent connection.

Direct connections—no harness cabling—no shorts.

Molded selector switch fully enclosed. Spiral spring index control—over 150,000 cycles without breaking.

Here's why top engineers and technicians use Model 630

Features like those shown above are what make this popular V.O.M. so outstandingly dependable in the field. The enclosed switch, for instance, keeps the silvered contacts permanently clean. That's rugged construction that means stronger performance, longer life. And tests show that the spiral spring index control, after more than 150,000 cycles of switch rotation, has no disruption or appreciable wear! Investigate this history-making Volt-Ohm-Mil-Ammeter today: 33 ranges, large 5 1/4" meter.

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*If your
Pictures
look like this* →



YOUR TELEVISION WILL BE IMPROVED WITH A **WARD** OUTDOOR AERIAL

*to give you
Pictures like this* →

The modern miracle of pictures by air can be a most satisfying means of entertainment. But be satisfied only with a picture comparable to a class "A" motion picture—on every station in your area. It is unnecessary to compromise!

HERE'S WHY: Television waves are like light beams—solid objects reflect and refract them, making it impractical to pick up all stations from an indoor aerial. That is why you get double images on some stations. In addition, indoor aerials have poor signal pickup making it difficult to get good pictures on all stations.

FURTHERMORE: Your indoor antenna may have a high noise level which increases the amount of interference as you advance the contrast control to bring up a weak picture. All of these technical difficulties are eliminated by a WARD outdoor aerial installed by a competent radio serviceman. In every case, a Ward outdoor antenna will improve reception over an indoor aerial. Also, Ward aerials are so well designed, they are attractive on a house. It is unnecessary to compromise!



WARD is the largest and oldest exclusive maker of television and auto radio aerials.



Does the antenna on your automobile need repair? Replace it with
WARDS'S 8-BALL—world's largest selling auto aerial.

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1523 E. 45TH STREET, CLEVELAND, OHIO
Division of the Gabriel Company



RADIO & TELEVISION NEWS



The ANTENNA RESEARCH LABORATORY

By

JOSEPH M. BOYER

Consulting Engineer

Fig. 1. Tiny crystal receiver, shown in engineer's right hand, is used to detect signals from model antenna. Plate on side of model plane is removable to permit receivers to be installed within the hollow fuselage of plane.

Douglas Aircraft's laboratory eliminates costly full-scale experiments by using tiny replicas in solving complicated antenna design problems.

NEVER before in the history of radio has interest in the antenna beam been at such a feverish pitch! No longer are "aerials" merely required to transfer electromagnetic energy into space. Experts today, working with surrealistic shapes of metal and plastic, are molding radiated energy into the precisely shaped beams needed for the varied classes of radar—for highly eavesdrop-proof communication links, or even changing the beam's contour from instant-to-instant, automatically following the boiling vagaries of the Heaviside layer.

The center of all such investigation is the antenna research laboratory. Here antenna engineers work with worlds in miniature. Out on the model antenna range of one such laboratory it is not uncommon to see a complete scale replica of a television station: the tiny buildings, the accurately-made antenna towers, even the green rolling hills of the surrounding country. This Lilliputian model slowly revolves on a turntable, a large horn-type radiator some distance away "illuminating" it with microwave signals. The miniature antennas of the model station detect such energy and feed it back to high gain amplifiers in the laboratory. Thus, as the model turns,

automatic plotting instruments draw an accurate trace of the radiation pattern of the station for later study. Such model tests save costly cut-and-try procedures previously made on full scale installations.

Even more important, in view of our National Preparedness Program, is the investigation of aircraft antennas. With aircraft now operating both near and beyond the speed of sound, no object of any kind is permitted to project from the sleek, polished metal skin to add parasitic drag. This requirement is a death warrant for the numerous masts and wires which once were draped lavishly over aircraft exteriors. In the high-pressure search for distinctly new antenna types which may be faired flush into the skin of a high speed airplane, several of the large airframe manufacturers have aided the radio art immeasurably by taking the lead in such research. In order to see, at first hand, the evolution of a new antenna, a visit was made to the El Segundo, California antenna laboratory of the Douglas Aircraft Company which pioneered in this field. Here, work begins with the presentation of the Navy specifications to the aircraft antenna designer.

*Military frequencies are classified. Those given are only representative.

Such specifications call for a v.h.f. communications antenna. This unit is to be mounted flush within the skin of a high speed carrier type fighter, yet provide full 360-degree coverage about the horizon. When used for transmitting, the antenna must produce most of its signal in a zone approximately twenty degrees above and below the airplane. Efficiency must be equal to the older type protruding antenna because airborne power requirements are stringent. Finally, as if to complete the designer's frustration, such an antenna must be capable of operating from 300 to 590 megacycles while remaining matched to the coaxial transmission line feeding it. Specifically, it must not exceed a voltage standing wave ratio of 2 to 1.

The resourceful engineer begins a strenuous period of reading the available technical literature, making rough preliminary calculations, and weighing and discarding a number of configurations which come to mind. In this process the crude pencil sketches which litter his desk would be unrecognizable to prewar engineers. There is not a sign of wires or porcelain insulators. One sketch may show a small square portion of the metal skin isolated from the surrounding surface and fed by a tapered funnel section of coaxial line. Or perhaps a flat disc of polystyrene a foot or so in diameter is shown, excited at its center by a sphere of silver designed to function as a wide-band dipole.

Finally, the antenna designer may feel he has what is needed. Before he makes a preliminary shop drawing he must refine his design. This step involves extremely complex calculations. For some such problems he must discard his slide rule, set up the equations he wishes solved, and pass them on to electronic or mechanical

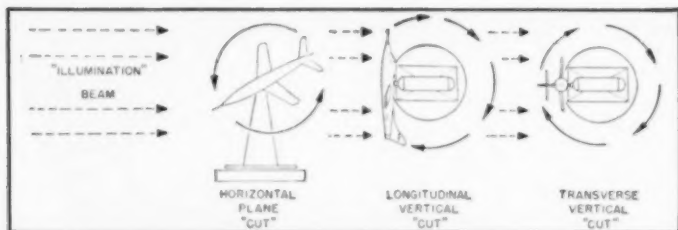


Fig. 2. Diagram shows position of model aircraft and rotation axis for each of the three principal radiation pattern "cuts" made during pattern study.

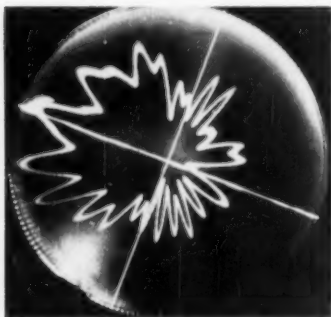


Fig. 3. Typical aircraft antenna radiation pattern. The pattern shown was photographed on the screen of antenna range cathode-ray "pattern painter." Magnetic deflection coils move in synchronization with rotation of model under study, tracing out an accurate polar diagram of antenna signal variation around the plane model.

computing machines. Satisfied that his "brain child" has a good chance of success, the engineer authorizes the experimental shop to fabricate a full size antenna and pass it on to the antenna laboratory for measurements.

Impedance Measurements

The antenna laboratory technician, highly-trained and experienced in this

specialized field, first may mount the prototype antenna upon a large *ground plane*. This usually is a metal wall forming one side or the roof of the laboratory building. In some cases the antenna may actually be mounted into a full scale wire cloth *mock-up* of the aircraft itself. A precision section of slotted coaxial transmission line (Fig. 5) is connected in series with the antenna and a laboratory v.h.f. oscillator. Beginning at one end of the frequency range to be covered by the antenna, the technician makes measurements of the voltage standing wave ratio in the transmission line. If the antenna is a perfect match there will be no change in the measured voltage from one end of the transmission line to the other. Such "flat" lines, however, are rarely encountered. There usually is a small v.s.w.r. but it must be under the called-for 2:1 ratio. If the designer has done his job properly this condition will be met over the entire frequency range desired. So far so good, but more hurdles remain to be cleared.

Once more an order goes to the experimental model shop: "Fabricate one 1/20th scale model of the antenna for range pattern tests." The men who receive this assignment are not ordinary machinists or metalsmiths. They are, for the most part, former instrument makers used to working with tiny precision parts under a pow-

erful lens. They are fantastically ingenious in devising ways of soldering and welding parts the size of a pin head into place within complex assemblies, of bending and twisting metal into shape while it is glowing in the flame of an alcohol lamp. An idea of the difficulty of their job can be obtained when it is realized that ordinary RG 8/U coaxial cable reduced to 1/20th scale is the size of store string. The inner conductor of such cable is the diameter of a human hair, yet must be soldered to the minute antenna without melting an extremely thin, easily-destroyed polyethylene sheath which insulates the assembly. Upon completing his exacting task, the model shop craftsman places the tiny antenna into the metal skin of a previously prepared 1/20th scale model of the aircraft in which it is intended to see service.

Radiation Pattern Measurements

Briefly, the basic idea behind the use of the model antenna pattern range is this: an aircraft operates far from the earth. The only environment which affects the antenna on the airplane is the configuration of the craft itself. Any attempts to measure radiation patterns on a full size aircraft resting on the earth would be futile. Patterns taken by means of flight tests are not only prohibitively expensive, difficult to measure and interpret, but usually end in doubtful results. However, by reducing the aircraft to 1/20th or 1/40th of the full scale dimensions it is possible to mount it from 40 to 60 wavelengths from the ground. This can be done because the operating frequencies must also be multiplied by 20 or 40 to keep in step with the model dimension change. That such theory is correct, when suitable precautions are taken, has been demonstrated conclusively.

The scaled-down model aircraft, complete with its test antenna, is mounted upon a special dielectric

Fig. 4. Operating and recording position. Shown are the v.h.f. and microwave transmitters, power supplies, and switching panel. In front of operator is a pen recorder and the Douglas cathode-ray "pattern painter." The "full moon" labeling device is seen as the white window below the cathode ray tube.

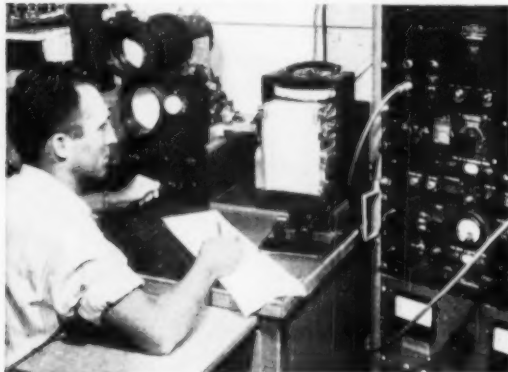


Fig. 5. A coaxial slotted line in use. The slotted coaxial line is used to measure the voltage standing wave ratio of the prototype antenna. The radiator under test is mounted on the outside metal surface of the wall, directly behind the Hewlett Packard Voltage Standing Wave Ratio meter shown in photo.



tower, the base of which rests on a motor-driven turntable. Within the hollow belly of the little plane is a simple receiver usually consisting of an impedance matching transformer and a silicon crystal detector or hot wire bolometer.

With the tower placed as many as 100 wavelengths from the laboratory building, technicians energize a tunable Klystron transmitter which excites a large horn type antenna projecting toward the model through the wall of the laboratory. The transmitter's signal is amplitude modulated by a square wave with a repetition rate of 1000 cycles. A square wave is needed to avoid frequency modulation of the Klystron. Operating frequency is carefully adjusted to be 20 or 40 times the full scale point in the spectrum where the antenna is intended to function.

Reference to Fig. 2 will make clear the patterns to be described. The antenna specialist refers to such patterns as "cuts." The first "cut" is made by slowly rotating the model so that every portion of the plane's horizontal axis is exposed to the radio beam from the laboratory transmitting horn antenna. The model on the tower is then turned 90 degrees and again rotated by means of the turntable, exposing its nose, belly, topside surface, and tail to the beam. Finally, a "cut" is made presenting the wingtips, belly, and topside surface of the model. This triad of cuts—the horizontal, longitudinal vertical, and transverse vertical, are fundamental in any pattern investigation and quickly tell if the radiation pattern of a new antenna is going to meet specifications. At least the three patterns just described must be made at frequent intervals over the simulated radio spectrum in which the antenna is going to operate. An antenna may frequently have the desired radiation pattern at one end of its frequency range and fail miserably at the opposite extreme.

Leaving the antenna designer for the moment with his problem let us enter the laboratory building proper and investigate the equipment used to study the radiation characteristics of antennas. Several racks of audio amplifiers are the first instruments seen. These are quite special items. There are preamplifiers capable of boosting the few millivolts or so of signal received from the model to about 10 or 20 volts. This piece of equipment is linear in response and features a tuned feedback network which permits the amplifier to operate with full gain only at 1000 cycles. All other signals of random frequency and noise are sharply attenuated. The output of the linear preamplifier drives a logarithmic amplifier which is also sharply tuned to 1000 cycles. Logarithmic response is desired so as to properly record variations in the model signal which may extend over 50 decibels or more. To graphically present the radiation pattern several different types of recorders are used.

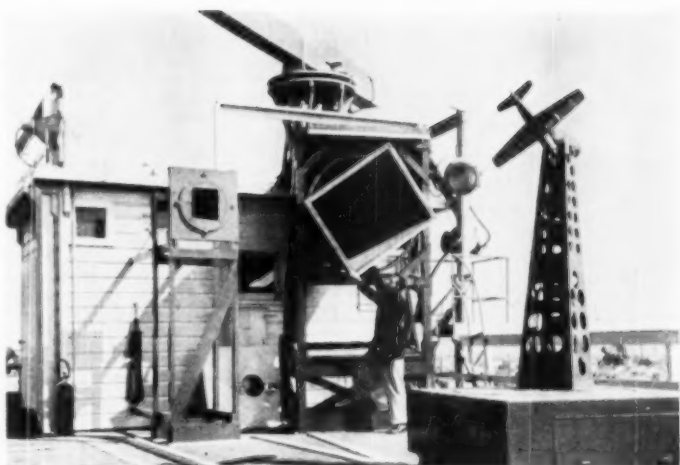


Fig. 6. General view of antenna model pattern range. A scale model of the Douglas "Skyraider" is shown mounted on the motor driven dielectric tower. The large electromagnetic horn antenna to the right is being turned to change electric polarization of signal to model. Smaller horn to the left of the picture covers the three centimeter frequency range.

The most common is a so-called polar recorder in which a pen is driven by signal variations from the model through the use of a servo-mechanism. In appearance this unit may resemble an automatic phonograph record changer. A circular piece of polar graph paper is placed upon its turntable and centered by means of a pinpoint of light at the center. The paper edges are clamped down by means of small Alnico magnets. Rotation of the recorder turntable is synchronized by means of selsyns to turn in step with the model out on the pattern range. When the model is rotated the servo-driven pen moves back and forth on a radius, tracing out the pattern.

Also used is a cathode-ray pattern

painter illustrated in Fig. 4. This instrument has several important advantages over the pen type recorders. One of the most valuable is lack of mechanical inertia. There are occasions when a radiation pattern being recorded varies from a deep null to maximum signal intensity within a fraction of a degree of rotation. Even for the slow speeds at which the model turns ($\frac{1}{2}$ to 1 r.p.m.) this condition requires the pen to whip over the graph paper at an exceptionally fast rate. The consequent lack of response and "overshooting" of the pen distort such patterns.

This difficulty is absent in the cathode-ray "pattern painter." Here the magnetic deflection coils actually rotate about the neck of the cathode-

Fig. 7. Scale model aircraft and antenna shown in process of construction. Craftsman in foreground solders a connection in minute cavity type slot antenna. The 1/20th scale aircraft model shown is of wood.





Fig. 8. Closeup of 1 cm. transmitter and horn antenna. A complete 30,000 mc. Klystron transmitter, cavity wavemeter, and high gain horn radiator makes only a light handful of microwave equipment.



Fig. 9. Slot antenna and cable. The size of a pair of 1/20th scale slot antennas and miniature coaxial cable may be judged by comparison with hand holding them.

ray tube in synchronism with the model. Thus, as the signal intensity changes the electron beam can follow the speediest variation with no time lag, no error. When used for radiation pattern plotting the screen (long persistence) of the tube is photo-

graphed on 35 mm. film for a permanent record (Fig. 3). Another fine feature of the particular model developed at the Douglas laboratory is an edge-lighted *Lucite* disc seen in the illustration mounted below the cathode-ray tube. This disc is called the "full moon" because of its characteristic of glowing with evenly distributed white light. All pertinent data such as frequency, aircraft type, and description of the "cut," is typed on transparent gummed paper and this is then fixed over the face of the "full moon." Easily photographed on the same film as the pattern, such a screen label feature permits the laboratory to obtain a very complete, foolproof record of work in progress.

Frequency Coverage

Antenna laboratories must have transmitters available to cover enormous ranges of frequencies. To see the reason why, let us assume that the full scale frequencies of three antennas to be tested span the region 80 to 1600 megacycles. Not only must oscillators be on hand for these exact frequencies but, in addition, if the model range measurements are to be made at 1/20th scale, r.f. generators are required for the simulated range 1600 to 32,000 megacycles. Spanning such an expanse of radio territory calls for an imposing collection of coaxial cavity, and "butterfly" type oscillators, many, many Klystron tuners as well as elaborate high-voltage regulated power supplies and frequency measuring equipment of great accuracy. It is no wonder that antenna engineers always ask for bargains in frequency coverage when shopping for transmitters; otherwise such equipment would overflow the laboratory.

To cover the multitude of problems

which trouble an antenna specialist's slumber would be beyond the scope of this article. Some of the especially serious ones, however, may be of interest. The first and worst of these is spurious reflected signals. Exactly the same problem is faced by television service technicians in the form of "ghosts." The aircraft model itself is, of course, placed carefully "in the clear." Any posts, buildings, fences, or personnel in its vicinity would reflect signals into the model as if they were secondary transmitters. Such reflections, depending upon their instantaneous phase, either add or subtract in certain directions from the true magnitude pattern of the model.

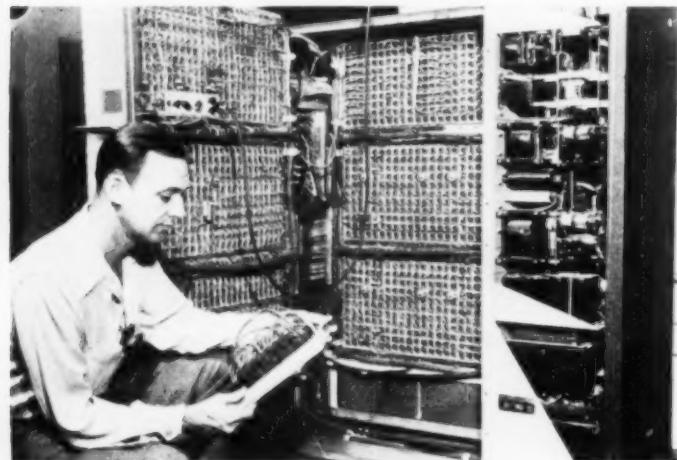
The real villain of this story, however, is the ground or platform upon which the antenna laboratory rests. "Splash" from this source is almost impossible to eliminate completely. Great care is exercised in designing the large sectorial horn antennas which "illuminate" the models so that just enough beam width with uniform phase front is produced to cover the model with r.f. energy. Even though this precaution lowers the magnitude of floor "splash" it does not completely remove it. Sometimes low metal fences properly called *defraction edges* are placed on the model range to deflect the "splash" signal into a harmless area. Placing these fences for each frequency used (and sometimes as many as 200 "cuts" are made on a single model) is more of an art than a science.

Another troublemaker is the small coaxial cable which conveys the detected signal from the model down the tower to the laboratory. This is, of course, a metallic conductor of many wavelengths projecting from the model. Pattern distortion will be introduced by this cable, and only highly experienced personnel can minimize this difficulty by judicious placement of the cable when setting the model up for a "cut." To overcome this hazard some researchers have actually placed midget transmitters inside the model aircraft. Battery power or an air-driven generator energized by a high pressure hose are used, but the attendant cooling problems and frequency drift due to lack of power supply regulation makes this technique a last resort measure.

The problem of distance in wavelengths at the operating frequency between the model under test and the "illuminating" horn antenna poses, at times, a nightmarish enigma for the antenna worker. In order that an accurate radiation pattern be secured, the model aircraft must sometimes be placed as many as 100 wavelengths from the laboratory antenna, otherwise true "free space" conditions are not realized. Even at the microwave frequencies 100 wavelengths may be a sizable distance physically. Unfortunately, the power output of laboratory type Klystron tubes is only about 200 milliwatts for the region up to

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Fig. 10. View of computer showing vacuum tube bays. Mathematician inspects plug board which inserts problem into the 1285 vacuum tube electronic computer used to solve complex antenna equations. Such machines are now routine tools in the search for new antenna designs and antenna improvements.



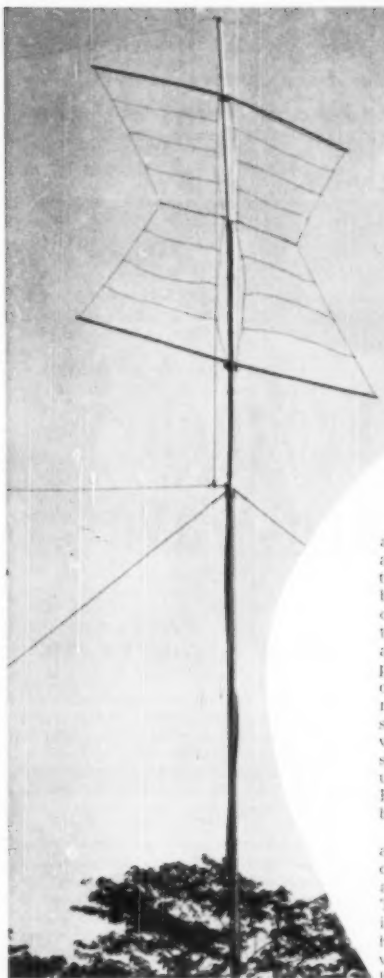


Fig. 1. Test model of the batwing FM receiving antenna installed on author's home.

By
R. CAMERON BARRITT

THE batwing antenna is an extremely wide-band radiator developed by RCA for television transmitting. In its omni-directional form, it is known as the "superturbo-stile" and is used by nearly all television stations. This "current sheet" antenna has been employed for FM transmitting, but so far has been given little attention as an FM receiving antenna. In our opinion, it has many advantages and is worthy of consideration. A single element used as an FM receiving antenna results in bi-directional high gain over the whole FM band. For those who, like the writer,

The Batwing FM RECEIVING ANTENNA

A single element will provide high-gain reception over entire FM band. In some areas its bi-directional pickup pattern is a desirable feature.

are situated so that desired stations are in two opposed directions (Fig. 2), the figure 8 pickup pattern may be best utilized. The pattern in the vertical plane is similar to that of two vertically stacked dipoles $\frac{1}{2}$ wavelength apart; however two dipoles so situated present their highest impedance at only one frequency because the natural resonance of a dipole is sharpened in stacked arrays. The wide-band batwing does not exhibit this undesirable single-frequency effect, and has almost unchanging impedance over the whole FM spectrum while still retaining its bi-directional high-gain feature.

Important dimensions of the antenna are shown in Fig. 3. These are not critical. The two edges of the wings are grounded and are fed at the center. The area within the wing may be filled in at the discretion of the constructor, however, to eliminate the dangerous wind resistance, this area should not be solid. Copper screening or chicken fence wire may be used. If horizontal members are utilized, there should be at least seven between top and bottom.

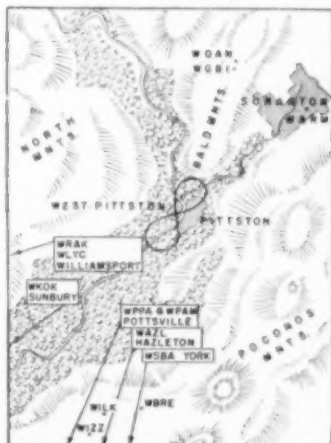
Fig. 1 is a test model constructed quite inexpensively of two $\frac{1}{2}$ " diameter aluminum tubes and some 7/22 copper antenna wire. The antenna is mounted on the roof of the writer's home, 50 feet above street level, and is affixed to a 25-foot mast made of $\frac{1}{2}$ " and 1" conduit and $\frac{3}{4}$ " diameter aluminum tubing. A hundred feet of RG-8/U cable (available at five cents a foot) runs to the first floor from the roof. Since the batwing is a completely grounded type of antenna, the sheath of the cable may be grounded somewhere near the end, affording complete lightning protection. The output impedance of the antenna is not exactly the impedance of the cable (52 ohms), but is close enough for all practical purposes, as the wide-band radiator yields an unvarying standing wave ratio.

Our experimental batwing has performed extremely well, considering the fact that it is situated approximately 100 feet above the Susquehanna River, which is only 500 feet above sea-level at West Pittston. In spite of the poor location, we have managed to pick up WSBA, York, Pennsylvania, which is 110 miles distant. WKOK—Sunbury (60 miles), WRAK—Williamsport (65 miles), and WPPA—Pottsville (60 miles) are all received at limiter level.

The antenna shown in Fig. 1 was merely a test model, and although it has withstood the fierce March winds of Wyoming Valley, it is not expected to have a long life. It will be replaced with one fabricated entirely of aluminum tubing welded together. It is con-

(Continued on page 90)

Fig. 2. Map of a typical locale requiring a bi-directional antenna. All stations that can be received are either to the northeast or southwest, with the mountains blocking reception from either the east or west.





Single tube, square-wave clipper. Only 5 components are used in its construction—3 resistors, a battery, and a dual diode.

Wide Frequency Range Square-Wave Clipper

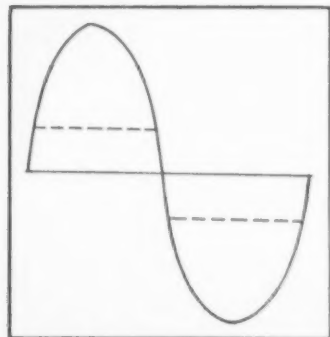
By
LOUIS E. GARNER, JR.

CHECKING the response of an amplifier to a square-wave signal provides the fastest and easiest method for testing frequency response, phase shift, transient response and similar characteristics. Unfortunately, commercial square-wave generators, particularly those covering a wide frequency range, are comparatively expensive and hence not easily available to the average service technician or experimenter.

However, a close approach to a square wave may be obtained by "clipping" the peaks of a sine-wave signal as illustrated in Fig. 1. A number of clipper circuits may be used to do this, the most popular being illustrated in Fig. 4A.

In operation, whenever the voltage of the input sine-wave signal exceeds the d.c. voltage applied to the diodes by means of small cells, the diodes conduct. Diode V_1 conducts on positive peaks and diode V_2 conducts on negative peaks. When either diode conducts, it acts practically as a short circuit and the input signal is dropped across series resistor R_1 .

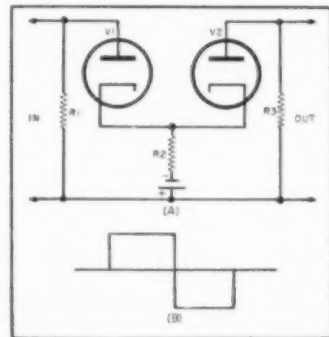
Fig. 1. Principle of clipper circuit. Peaks of sine wave are clipped to get square wave.



The effectiveness of clipping in this manner depends on the combined value of the diode resistance (when conducting) and the battery resistance in comparison with the value of R_1 . If R_1 is very large compared to the combined diode and battery resistance, reasonably good clipping is obtained.

This circuit, though widely used, does not give a really close approach to a "perfect" square wave, and hence is not suitable where more exacting tests are required. First, regardless of how large R_1 is made, the diode and battery still have some resistance and a small voltage will appear across them. This voltage will vary with the changing resistance of the diode. Thus, a "rounded" square wave is obtained,

Fig. 2. Clipper circuit designed by the author. See text for values of components.



with both trailing and leading edges rounded somewhat and with a slight bow instead of a perfectly flat top, as illustrated in Fig. 4B.

In addition to this disadvantage, the circuit also has a limited frequency range, for as R_1 is made larger, distributed capacities become important and limit the frequency at which even a close approach to a square wave can be obtained.

By using a different arrangement, the clipper circuit shown in Fig. 2A can be obtained. This circuit, when properly driven, will provide almost perfect square waves, with sharp corners and a flat top, over an extremely wide frequency range.

In operation, diodes V_1 and V_2 are normally conducting and thus act as resistors, passing any signal applied to the input. However, when the peak of the input signal exceeds the battery voltage, then one of the diodes stops conducting and acts as an open circuit, preventing further passage of the signal and effectively clipping the peaks.

On negative peaks, the plate of V_1 is made negative with respect to its cathode and hence it stops conducting and acts to open the circuit. On positive peaks, diode V_2 continues to conduct, but the cathode of V_2 is made positive with respect to its plate and this tube acts to open the circuit.

A practical circuit can be built using a 6AL5 dual diode, a 1.5 volt single penlight or flashlight cell, and half-watt carbon resistors. R_1 and R_2 have a value of 18,000 ohms, and R_3 has a value of 2200 ohms. Filament voltage

can be obtained from the amplifier under test, or a small filament transformer can be provided.

In the clipper circuit built by the author, using these values, an almost perfect square wave was obtained with a constant amplitude of 1.5 volts peak-to-peak over the range 20-20,000 c.p.s., when driven with a sine wave having an amplitude of approximately 90 volts peak-to-peak. It could not be determined how high in frequency this clipper would continue to produce a square-wave signal since no sine-wave source supplying a signal of sufficient amplitude was available. However, since the resistor values are low, minimizing the effects of distributed capacities, and since no "frequency conscious" components are used, the maximum frequency at which a good square wave could be obtained should be comparatively high.

As in any clipper circuit, the square wave can be improved by increasing the amplitude of the input sine-wave signal, and, by using a signal of sufficient amplitude, a square-wave with an extremely short rise time can be obtained. Normally, the amplitude of the input signal should be from 50 to 100 times the amplitude of the output square wave.

In this circuit, the level of the output signal remains constant at the battery voltage. If a higher output voltage is desired, additional cells can be connected in series to increase the d.c. voltage and the level at which clipping starts. In this case, however, it is necessary to increase the amplitude of the input sine signal still further if a good square wave with a short rise time is to be maintained.

Application

When testing either a single stage or a complete amplifier, the equipment is arranged as shown in block diagram form in Fig. 5. A good oscilloscope and a sine-wave signal source are required in addition to the clipper. The square-wave signal at the output of the clipper is first observed on the oscilloscope. Next, the output signal from the amplifier is observed and any departures from a perfect square wave noted.

It is best to adjust the horizontal sweep of the oscilloscope so that at least two complete cycles can be observed on the screen.

An input square wave and distorted square waves showing the effect of different amplifier characteristics are shown in Fig. 3. The perfect input square wave is shown in Fig. 3A.

A drop-off in high frequency response in the amplifier causes "rounding" of the leading edges of the square-wave signal as shown in Fig. 3B. Usually, the rounding off will be easily noticeable if there is a decided drop in amplifier gain by the tenth harmonic (or less) of the square-wave fundamental frequency. Thus, if a 1000 c.p.s. square wave is passed without appreciable rounding, you can be reasonably sure that the amplifier is

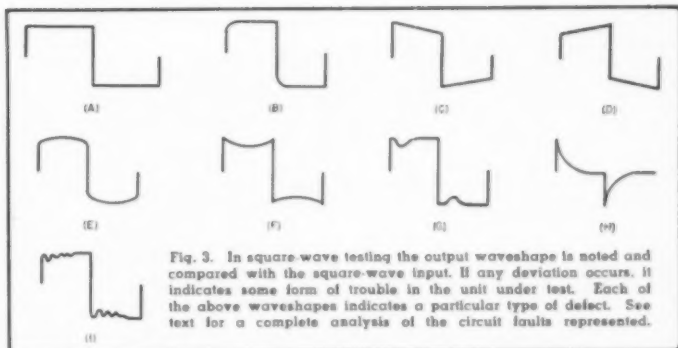


Fig. 3. In square-wave testing the output waveshape is noted and compared with the square-wave input. If any deviation occurs, it indicates some form of trouble in the unit under test. Each of the above waveshapes indicates a particular type of defect. See text for a complete analysis of the circuit faults represented.

"flat" to 10 kc. But this gives no indication of the response below the fundamental frequency of the square wave. To do this, a lower frequency square wave is required.

Since this clipper, when properly driven, can easily supply a 20 kc. square wave, it can be used for checking the response of wide-band amplifiers (up to 200,000 c.p.s.) as well as audio amplifiers.

If there is phase shift in the amplifier so that phase leads at low frequencies, the top of the square wave is tilted as shown in Fig. 3C. If phase lags, the tilt is as shown in Fig. 3D. The amount of "tilt" depends on the degree of phase shift. Phase shift is usually not too important in audio amplifiers, as the ear is unable to detect it. However, in video and oscilloscope amplifiers no phase shift should be present.

The effect of accentuated gain at low frequencies is shown in Fig. 3E, while the effect of a drop in gain is shown in Fig. 3F. The drop in gain (Fig. 3F) is at the fundamental frequency of the square wave. It is assumed that there is no phase shift in both cases.

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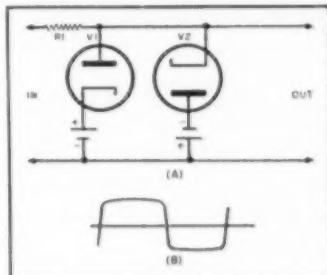


Fig. 4. Diagram of square-wave clipper tested by the author. Its waveshape is not as sharp as that of the final circuit shown in Fig. 2.

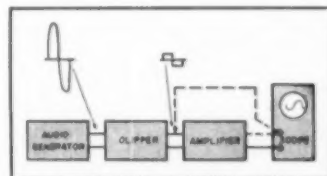
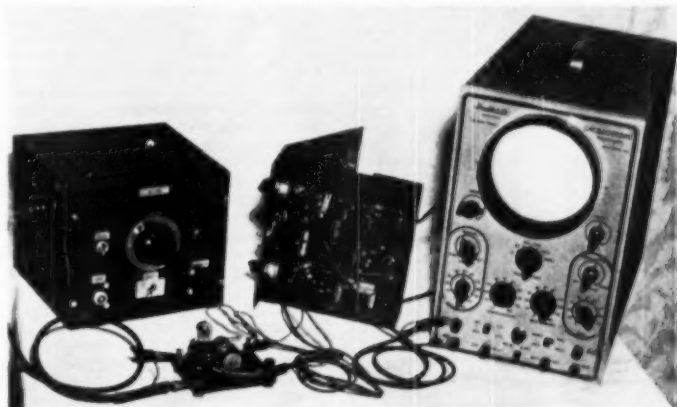


Fig. 5. Test setup used for checking audio amplifiers. It is pictured in photo below.

Clipper connected for checking the characteristics of an audio amplifier. The sine-wave audio oscillator is to the left, the test amplifier is in the middle, and the oscilloscope appears at right. The clipper itself is in the foreground.

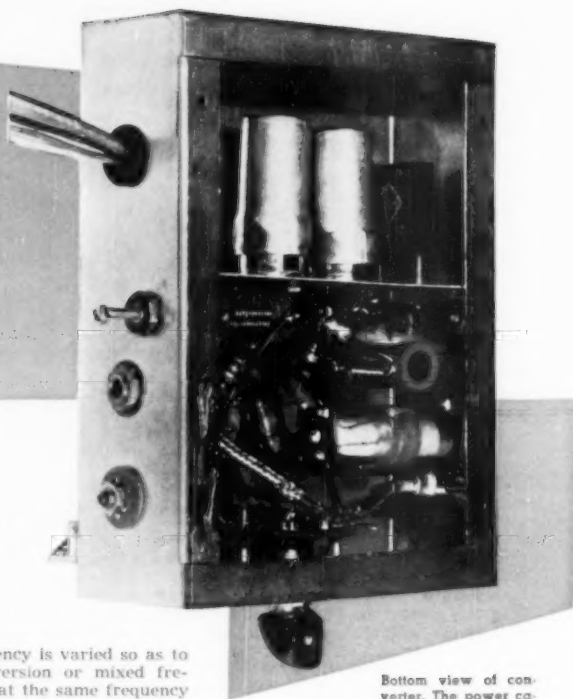


BROADBAND CONVERTERS

By

ALVIN B. KAUFMAN, W6YOV

Construction details for several types of short-wave converters for use on the 75, 40, 20, and 10-meter amateur bands.



Bottom view of converter. The power cable and antenna RG 29 U wire to the receiver are at top left, while the r.f. trimmer, mike jack, and antenna padder are directly below.

AN EXAMINATION of the short-wave converters available commercially reveals several deficiencies both from the financial angle and because of technical imperfections.

The amateur or SWL, either with limited finances or with the desire to build a really simple though excellent 75, 40, 20, or 10 meter converter without any of the bugs and complications attendant with most such units, will be pleased by the simplicity and straightforward design of this converter.

In general, there are two types of converters presently in use. By far the most common is the tunable converter wherein the receiver is tuned to a fixed point and the converter

oscillator frequency is varied so as to produce a conversion or mixed frequency, always at the same frequency to which the receiver is tuned. The other type of converter, not commonly in use, employs a wide-band r.f. input and output and a fixed frequency oscillator. This is the "broadband converter." Its output frequency varies with the frequency of the incoming signal and must be detected by tuning the receiver rather than the converter. The converters to be described are of the "broadband" variety with another important innovation added, crystal control, in some cases of a very unusual type.

One common complaint with practically all high frequency converters is frequency drift, and for the builder without a signal generator this presents difficulties in securing proper operation. Crystal control eliminates both of these troubles. There are no tricky adjustments or trouble encountered in tuning or finding the frequency range that this converter covers. With the proper crystal frequency your car or house radio tunes the ham band as a perfect "bandspread" unit. Transmitting or receiving type crystals are used in the converter; the crystal frequency and type of converter to use for the different bands will be indicated during a discussion of the three converters shown schematically. The crystals used are not expensive as an accurate frequency is not required. No special frequency is required for the ten meter band.

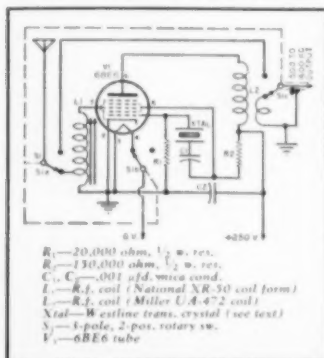
A one- or two-tube converter of this type admittedly does not have the gain of a four- or five-tube unit, but neither

does it cost as much. In its field of use its good points certainly outweigh any objections to lowered sensitivity or a little loss of bandwidth when used on the ten meter band. On the ten meter band the author has received signals from all over the country (2-tube unit) and considers the sensitivity satisfactory.

There is one prerequisite that must be met if a broadband converter is used. The broadcast receiver tunes in the converted signal as if it were on the broadcast band. This means that the BC receiver must be completely "dead" with close to full volume when its antenna is not connected. Car radios being well shielded generally have no pickup, but the average inexpensive a.c.-d.c. may have excessive pickup in which case it would interfere with the short-wave signal. In any case a shielded cable must be used from the converter into the broadcast receiver. This cable should be of the low loss coaxial type such as the RG 29-U, etc. With the converter connected to the receiver a small amount of broadcast signal may come through until the converter warms up and supplies a signal and background noise to operate the a.v.c. in the receiver.

Three converters were designed by the author. The 6BE6 converter was designed primarily for 75 and 40, while the dual 6AG5 unit was designed pri-

Fig. 1. Schematic diagram of 75- and 40-meter converter. It can also be used, though not desirable, for 20- and 10-meter operation.



marily for 20 and 10. Although either unit may be employed for any band there are reasons which make each better suited for a different range of frequencies.

The 6BE6 converter (Fig. 1) employs a pentagrid tube with a crystal controlled oscillator section. Starting at the antenna, the r.f. signal may be tapped into the r.f. coil a few turns from the bottom or fed in through the all impedance matching network as shown in Fig. 3. This coil is of the high "Q" type. A National XR-50 coil is wound according to the specifications given in the coil table accompanying Fig. 3. This variable iron core coil and the tube's input capacity permit tuning throughout the band. The coil shows high "Q" over a wide frequency range, falling off rapidly outside this range. Rather than lower the "Q" by loading the coil with a resistor, which would "broaden the response" at a loss of the center frequency gain, no loading devices were used. Summed up in simpler words, the unit will be "hottest" near the peaked frequency of the coil. This coil's iron core should be adjusted after it is connected to the antenna so that it will resonate close to the frequency at which the transmissions are taking place or to any section of the band where peak performance is desired. In actual practice the per-

formance of the antenna coil are connected and are common on one post. These leads must be unsoldered and one wire shifted to the unused lug available on the Micarta strip. The associated aluminum shield can may be discarded to provide a more compact converter.

The use of a broadband broadcast frequency coil in the plate circuit of the converter makes special shielding unnecessary. Where both the plate and grid circuits are tuned to the same frequencies (some converters) careful shielding is required or the circuit may "take off" into tuned-plate, tuned-grid oscillator action.

As the crystal oscillator is of the Pierce type, no tuning is required in its circuits. Thus it can be seen that with the proper crystal, only the antenna input coil requires tuning to make the converter operative. This coil is tuned by operating the converter into a receiver without a.v.c. or into a short-wave receiver with an "S" meter. The receiver is tuned until a signal is received and then the coil is peaked by screwing the iron core in or out, as required. The windings for L_{in} , the input coil, are the same for all three units and are indicated on the schematic.

The 6BE6 converter, as can be seen, is a choice converter for 75 and 40 meters; only two coils, two resistors, two condensers, a crystal, and a tube

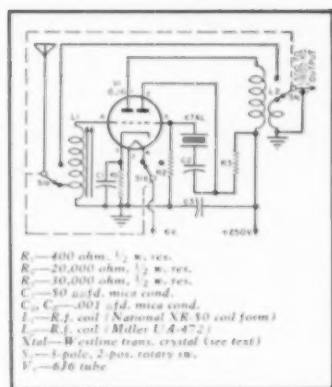
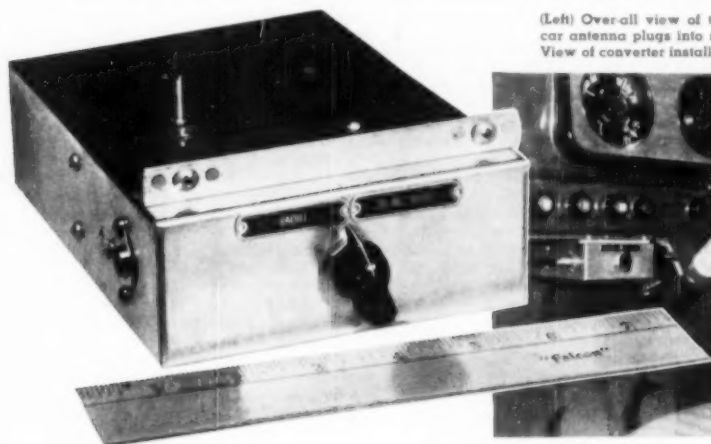


Fig. 2. Ideal, single tube, 10-meter converter.

ful 40 and 20 meter signals produced an undesirable signal in the receiver. The converter can be used for all bands by switching crystals and r.f. input coils, but, as indicated, is best suited for 75 and 40 meters.

The crystals used in any of the converters may be of either the transmitting or receiving type. Westline transmitting crystals were used by the author. The crystal frequency selected should preferably be at the low fre-



(Left) Overall view of the home-built dual 6AG5 converter. The car antenna plugs into receptacle on the left side of unit. (Below) View of converter installed under the dash of author's Studebaker.

formance over the complete band is quite satisfactory.

The plate of the 6BE6 is connected to a Miller UA-472 r.f. coil. This coil is a broadband broadcast coil designed to couple an antenna to the grid of the first r.f. tube, which is untuned. Here it is used in reverse. The grid winding is used as the plate winding in the converter, while the antenna coil feeds the converter output into the broadcast receiver's antenna input. This coil must be modified slightly from the manufacturer's configuration to fit this circuit. The grid return and bottom

being required. And it works excellently. It can be used on 20 or 10 meters, but as crystals with a fundamental mode of oscillation are made only down to 40 meters, it becomes necessary, when using a 40 meter crystal in the circuit, to employ its second or fourth harmonic, as developed in the tube circuit, to beat with the incoming 20 or 10 meter signal. The author has used this converter with a 40 meter crystal on the ten meter band. Its sensitivity is fair but not as good as the dual 6AG5 circuit where a 10 or 20 meter signal is injected into the mixer tube. Although the input coil was tuned to 10 meters, certain power-

frequency end of the band. This is so that as the incoming short-wave signals increase in frequency the resultant conversion frequency is also higher and thus the receiver is tuned to a higher frequency. On certain bands this permits adding a factor to the broadcast receiver dial and reading it directly in short-wave frequency! The crystals should be of the following frequencies. A 3000 kc. crystal should be used for the 75 meter band. Here the low frequency end of the band, 3500 kc., will appear at 500 kc. on the broadcast receiver while 4000 kc., the high frequency end of the band, will appear at 1000 kc. on the dial, etc. Thus for

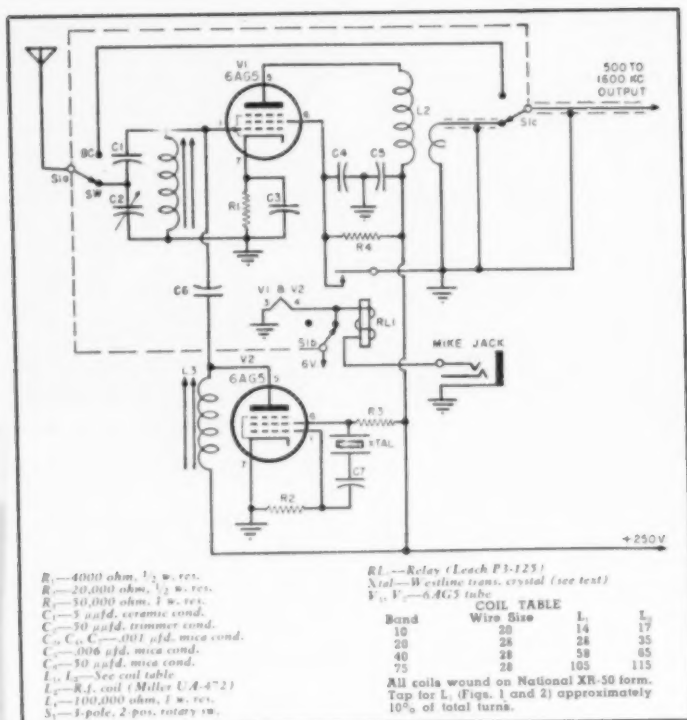


Fig. 3. Ideal, two tube 20 and 10 meter converter. Winding data for r.f. coil, L₁, covering 10, 20, 40, and 75 meter operation, also applies to r.f. coil L₂, shown in Figs. 1 and 2.

the 75 meter band a factor of 3000 would simply be added to the dial indication. Any crystal frequency close to 3000 kc. would be satisfactory and such crystals may be found in surplus stores or can be ground on special order for a few extra dollars. A 2500 kc. crystal could be used, in which case the 75 meter band would fall between 1000 and 1500 kc. on the receiver. The crystal frequency selected depends, to a large degree, on how accurately you wish the broadcast dial to reflect the short-wave frequency! For the 40 meter band a crystal frequency of 5860 to 6500 kc. can be used. However, 6000 kc. is preferable as the low frequency end of the band would appear at 1000 kc. on the receiver and the broadcast dial would be read directly in short-wave frequency by adding a factor of 6000. The 20 meter band would be covered by a crystal frequency of 6450 to 6750. Again 13,000 kc. would be best, the low frequency end of the band appearing at 1000 kc. on the receiver. A factor of 13,000 would be added to make this band track on the receiver. In this case a 6500 kc. crystal would be used in the separate oscillator circuit, Fig. 3, and its second harmonic of 13,000 kc. injected into the mixer tube. These lower frequency bands present no problem of frequency coverage as they are only 300-500 kc. wide and thus the radio receiver gives more than ade-

quate coverage and sufficient band-spread to be satisfactory. The 10 meter band being 1700 kc. wide means that it cannot be completely covered by a broadcast receiver, but that the band-spread action would be excellent as the band covers more of the dial. Actually, for a given increment of dial movement, the receiver would tune the same frequency difference on any band and there would be no difference in selectivity on any of these bands. The proper crystal frequency for 10 meter coverage depends upon which section of the band you wish to receive. My choice is from 28.5 megacycles to 29.6 megacycles. This calls for a 7000 kc. crystal. Its fourth harmonic falls at 28 megacycles and thus by adding 28 to the receiver dial a 28.5 mc. signal appearing at 500 on the dial would be read 28,500. The factor would be 28 or 23,000. An advantage here is that 7000 to 7010 kc. crystals are easily obtainable as they are 40 meter crystals. To cover from 28,000 kc. up, a 6875 kc. crystal would be required. To cover from 29,700 kc. down, a 7050 kc. crystal is necessary.

The 6J6 converter (Fig. 2) is satisfactory for any frequency of operation, but has the same limitations as the 6BE6 unit for the two high frequency bands. It was determined that a triode mixer of this type does not have a lower noise level at these frequencies

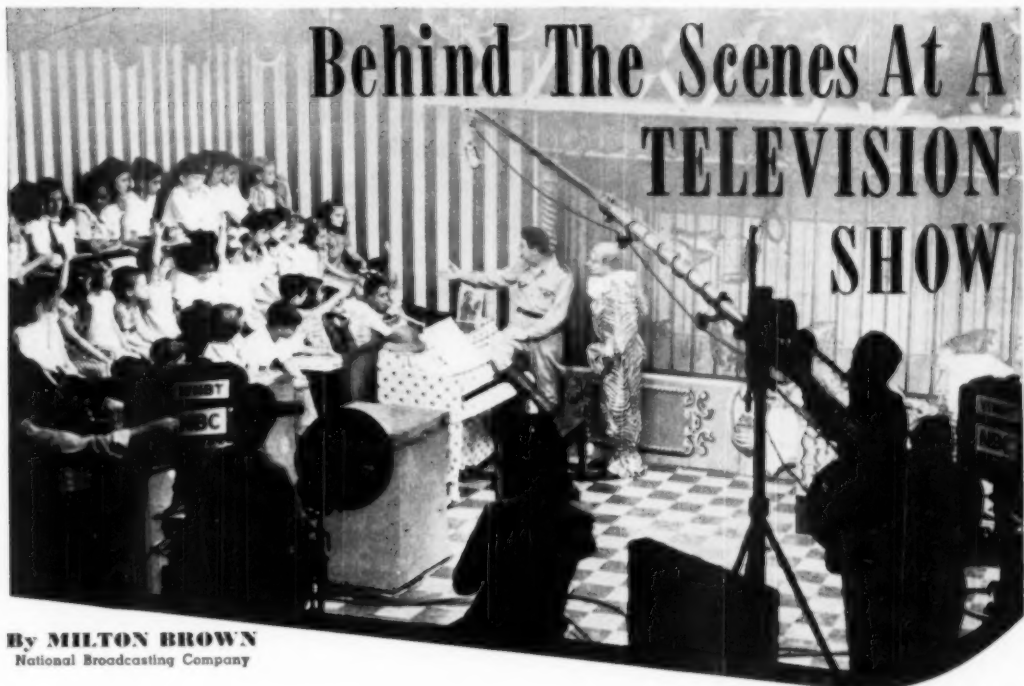
than the pentagrid or grid injected converter. The oscillator mixing action takes place in the common cathode resistor and the bypass condenser is critical, 50 μ fd. being the correct value for the 10 meter band. This unit compares favorably with the 6BE6 unit, but if the builder is starting from scratch, the latter is a better unit to build.

The dual 6AG5 converter (Fig. 3) is very satisfactory for 20 and 10 meter operation. This unit was designed and found suitable for these bands. It is needlessly complicated for the 75 and 40 meter band, the 6BE6 unit being comparable in performance and requiring less material. A 10 meter version was constructed and installed in the author's car to complete a mobile station. Although the previously mentioned points regarding crystals, coils, etc. also apply to this unit, there are additional features requiring explanation. During experimental development of this converter it was determined that the popular 6AK5 tube was not satisfactory for converter service for two reasons. This tube has a rated 180 volts maximum plate supply and the tubes tested were gassy enough to ionize at the admittedly high supply voltage of 250 volts d.c. The worst feature was the wide change in transconductance when the tube was subjected to vibration. The 6AG5 possesses neither of these objectionable features. Of course, this does not condemn 6AK5 tubes for other uses.

The oscillator section of the 6AG5 converter consists of a single 6AG5 tube whose screen grid circuit is wired as a Pierce oscillator and whose plate circuit is resonated (in this case) to the 10 meter band. A low frequency crystal is used, as outlined previously, and the plate circuit of the oscillator tuned to a multiple of the crystal frequency. Both the oscillator coil and r.f. input coil are tuned while operating the converter into a receiver. The receiver must have either an "S" meter, no a.v.c., or a very weak input signal applied to it. If a signal generator is not available any signal may be tuned in by the receiver on the ham band. Even without alignment there will be enough signals coming through for this purpose. After a signal or carrier is tuned in, the r.f. and oscillator coils are tuned by their iron cores for maximum receiver output. It is advisable to make the a.v.c. circuit in the receiver inert if it does not have an "S" meter, otherwise peak tuning is almost impossible. Where a high gain ham receiver is used for this tuning operation, a certain amount of broadcast leakage may be expected which will not appear with car or other radios.

The antenna may be coupled into any of the three converters by direct tapping into the coil or by the variable impedance antenna coupler as shown in the dual 6AG5 converter schematic. The variable impedance antenna coupling has been used on many other sig-

(Continued on page 145)



By **MILTON BROWN**
National Broadcasting Company

Back of the smooth and seemingly effortless show appearing on your video screen is a complex and highly trained organization of video technicians.

TELEVISION is a complex scientific operation, combining the action of light and optics, electricity and radio, physics and chemistry, electronics and photography.

One of the most complicated mechanisms in television is the camera—the instrument which is the basis of all television production.

Although the television camera resembles the motion picture camera, it practically begins where the movie camera leaves off. In regular photography, the scene to be photographed is picked up by a lens and focused on a strip of celluloid coated with a photosensitized emulsion and the action of the camera stops there.

On the other hand, the television camera is an electronic device which contains a tube, called the image orthicon, which translates the image transmitted from a lens onto a photosensitized surface into electrical impulses. These impulses are amplified and travel as such until they reach the television receiver in the home, where they are again translated into the image of the originally photographed scene. In greater detail, this is the route taken by a bit of action during a telecast:

The scene is picked up by the tele-

vision camera, the signal is amplified in the camera, sent through the camera cable to the studio control room, where it is adjusted and amplified, then sent through cable to master control, where it is amplified again, and from there to NBC's antenna atop the Empire State Building. At the same time that the telecast is sent to the Empire State Building from master control, it is also sent from there to the telephone company's network terminal point for transmission through the coaxial cable to stations connected to the network.

WNBT's television signal in New York is radiated from an antenna, located on the Empire State Building tower, to be picked up by home receivers. The video signals are brought into the set inside the house and appear on the screen. The sound portion of the program is picked up in the television studio simultaneously with the video, is amplified and transmitted in the same manner as any regular radio broadcast.

The technicians immediately concerned with pickup and transmission of any television show are specialists in many fields; some of the equipment they use is standard to radio and motion picture but most of it represents

Putting on NBC's "Howdy Doody" show at the WNBT studios requires the services of many highly trained technicians and engineers.

the best and latest in electronic achievement, a large portion of it designed by RCA and NBC engineers.

The following is to indicate the relationship of technician to equipment during the actual pickup of a video program:

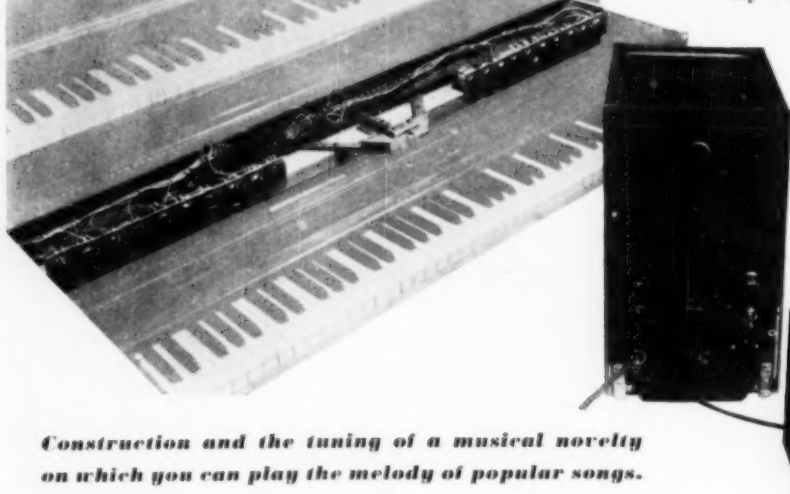
In the Studio

Camerasmen—Cameras: Usually, three cameras are used. Camera #1 is mounted on a dolly and is the only camera which is moved to produce moving shots—called dolly or truck shots—during the program. It is used for wide-angle shots. Cameras #2 and #3 are mounted on mobile pedestals, and while they can be moved, they do so only between shots. Each camera has a lens turret with a complement of four lenses of various focal lengths. In general, on camera #1, the lenses have 35, 50, 75 and 135 mm. focal lengths, while #2 and #3 have 50, 75, 135 mm. and 7½-inch focal lengths. For extreme closeups, lenses of longer focal lengths are available and are used when necessary. All lens changes are accomplished by means of a remote control handle in the rear of the camera. Changes in optical focus are made by means of either a focusing handle or a knob on the right side of the camera. While motion picture cameras are focused by moving the lens itself, in a television camera, cor-

(Continued on page 148)

A Home-Built ELECTRONIC ORGAN

By JIM KIRK, W0DEG



Keyboard showing the potentiometers and wiring pulled out from under the piano. The BC-605 cabinet with its portable PM speaker unit. Controls on the cabinet include R_{10} , R_1 (the volume control), "On-Off" switch, fuse, and the output jack.

Construction and the tuning of a musical novelty on which you can play the melody of popular songs.

I HAD taken the pledge and sworn off. Yes sir—from now on—no more surplus. Then our local junk dealer demoralized me by offering, right in his window, a stack of brand new BC 605's for \$5 per copy. That was too much of a bargain to pass up. Besides, I told myself, I need a cabinet and chassis for the experimental electronic organ I am building. A cabinet that I'd be proud to set on top of my piano. Furthermore, the parts I did not use would be worth much more than the price of the whole BC 605 with tubes. Just try and buy those leftover parts new and see what they cost. Just one more little purchase of surplus—the reader can guess what happened.

Search for a Keyboard

Then I needed a keyboard for my electronic organ. If I could get a keyboard that I could mount near or under my piano, I could use the electronic organ to play the melody and play chords on the piano to accompany it. I shopped at local toy stores for toy pianos. All they had were little plastic toy grand pianos. They would not do. They could not be taken apart without wrecking them. One shop did have a handsome little wooden toy piano. It wasn't so little, at that, and beautiful tunes could be played on it. It had 25 keys. That would suit my purpose fine but the price was \$24.50. With tax, that was five times what the BC 605 cost.

Silent Practice Keyboards

A canvass of the piano stores for practice keyboards revealed several

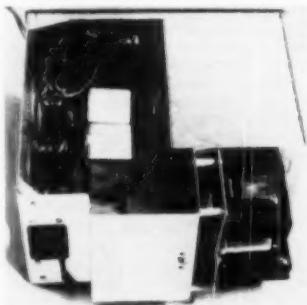
for \$49.50. Very beautiful—more keys than I needed and too costly. The last company had two *Virgil* "Claviers" for sale at ten dollars each. They were full size piano keyboards for soft or

Editor's Note: The author has used a surplus BC 605 unit to obtain a cabinet, miscellaneous parts, and a chassis. This is not necessary as any new or junk box parts and cabinet may be substituted.

Since only 11 notes are required to play the melody of most popular pieces a full piano keyboard is not required. The author used a "Clavier" with a standard-sized keyboard simply because it was available at low cost. The entire keyboard may be utilized by adding additional notes to the circuit as presented.

hard keying or for silent or click keying. It would be too simple to install a copper strip back of the moving metal fingers. The whole thing could be cut down and moved right under

Chassis view of the unit. The choke, condenser, and power transformer are shown mounted on a strip of aluminum. The 5Y3GT tube, not visible, is behind the choke and condenser.



the piano with the keyboard protruding. Just what I wanted. I bought the best looking one. Inside was some printing showing when the manufacturer's guarantee expired—the year I was born—1895!

Converting the BC 605

All the inside parts of the BC 605, including wiring, were removed, except the two tube sockets and two condensers. The front panel was left intact for appearance sake and because we are going to use the volume control, the switch, the fuses and the telephone jacks. A little strip of aluminum was mounted on the posts in the dynamotor well—identical to the method I use to power the popular BC 604 receivers. From the diagram it will be noted that two oscillator tubes in the one 6SN7 envelope are used. The reason being that the condenser and the resistance in the circuit control the frequency of the audio oscillation. If only one tube is used to cover the wide range wanted, a high resistance would be in the circuit by the time the low notes are wanted. The tube did not sound well on the low notes with a small grid condenser and a high grid leak. Better use one tube for the top half and another tube for the lower half. Since the 6SN7 tube is two tubes in one and since it takes up no more room than one tube and since surplus audio transformers are plentiful—two oscillators are employed.

Cutting Down Howls

The volume control is invaluable for playing and especially for tuning

RADIO & TELEVISION NEWS

up, if you have any regard for the neighbors. I did not want to further antagonize my neighbors—what with them already up in arms and threatening to chop down my transmitting antenna because of BCL. That was before I installed NBFM. I hasten to explain.

When I first got the electronic organ all connected up and ready to try out, I struck a low note and received the Bronx cheer. That was all right. I had always wanted to know how to duplicate the Bronx cheer electronically. Now I knew.

Tuning Up

You really need three hands for tuning up but if you are not so fortunate, there are two stunts you can employ. You can strike the piano note and remember what it sounded like, then hold down the organ key and try to tune the potentiometer to the same sound. You could put a roll of solder on the organ key and strike the piano note and tune—but it isn't much better than remembering. Start with the highest note and try to make it sound like high "F". Then try matching about four other keys. At this point, try playing some simple tune. If your experience matches mine, the tune will sound sick-like. However, if you have an ear for music, you can correct the sound better this way than by trying to match all the piano notes one by one.

Audio transformers will not oscillate unless the polarity is right. The method I employ is to go ahead and permanently hook the grid to "G" post and the "F" to the chassis. Then hook the plate to "B plus" and the power to the "P" post with flexible wires. If no oscillation, just reverse these flexible wires.

Using the Organ

The reason for wanting 21 notes on my electronic organ was so I could play the melody for all popular ballads. These notes—from high "F" to a low "A"—cover every note used in one hundred popular ballads I have on hand and am fond of playing on the piano. At first glance, the 21 potentiometers (22 with the volume control) look like the most expensive part of the outfit—but you do not reckon with my Scotch blood. I could have saved money by discovering the exact resistance needed in each case and using cheap one half watt fixed resistances, but that would not hold for every piano and it would not hold if the piano changes tune with age. With potentiometers one can keep the organ in tune, just like tuning up a violin. (My organ sounds like a violin, I insist.) Just because the potentiometers scratch a little when used as volume controls, does not impair their usefulness in this application except the volume control on the 605 panel. Being a radio serviceman, I had a flock of used volume controls on hand and I only had to use a value larger than the resistance I needed.

The audio transformers are surplus transformers from the GF 11 transmitter, but any inexpensive 3 to 1 audio transformers from the junk box will do as well because I have tried several in the experimental stages. You compensate with the potentiometers, anyway, so a difference in the transformers is not noticed. The only reason why I wound up with these surplus transformers is that they look neat and are handy to mount and wire in this application. Placement of parts and wiring is definitely not critical so the builder may easily deviate from this arrangement without harmful results.

It may be noticed that several of the potentiometers have switches. This is because some of the used potentiometers that I had on hand were

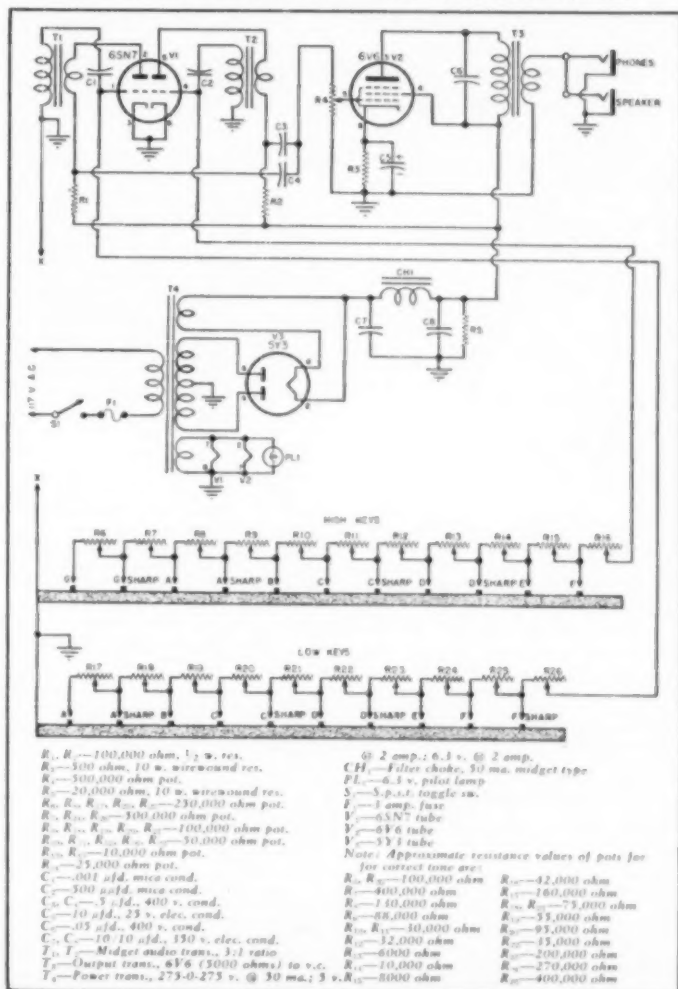
equipped with switches and I saw no reason for removing them in this application. The switch cover performs the function of keeping the dust out.

I must explain that this "organ" is tuned an octave lower than the melody for which the music is written. This is because it brought it in range of my singing voice and I can accompany my "music" with my rich baritone voice, if my guest insists. If you want to tune it to the melody that the music is written in, every key will be an octave higher and every potentiometer will have less resistance in the circuit. No change will have to be made in the components, however.

I built this organ five times before it reached its present form. I tried a neon oscillator first. Then I tried dif-

(Continued on page 111)

Circuit diagram and parts list covering the electronic organ. The approximate resistance values for the various potentiometers are given below the parts list.



An Effective SYNC "Lock-in" CIRCUIT

By
DAVID GNESSIN

*Details of a new circuit for television receivers
developed by Transvision and available in kit form.*

DOES your television horizontal hold control act skittish, requiring adjustment to a single sensitive position, otherwise the picture tears? You can lock-in the horizontal hold with the circuit described in this article so that once set a deliberate rotation of the control (up to 30 degrees of rotation) will not throw the horizontal sync out of hold.

Despite its efficiency this device is simple. Comprising a single dual-diode tube with its coupling circuit, this automatic frequency device leans over backwards to hold the sync locked even when the hold control is moved off oscillator frequency. This article will discuss the theory of operation fully.

Fig. 1A shows a simple sync amplifier. This could be an amplifier common to both horizontal and vertical sync, or it might be the horizontal sync amplifier alone. Note the phase

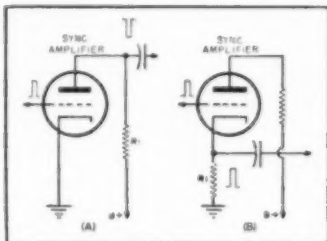


Fig. 1. Two versions of simple sync amplifier.

reversal of the sync pulse. Due to inherent plate amplifier action the positive sync pulse applied to the grid results in a negative sync pulse developed in the output.

Next examine Fig. 1B. By placing R_1 in the cathode circuit the sync pulse now developed in the circuit has the

same polarity as that applied to the grid input.

This leads to Fig. 2 where R_1 and R_2 are placed in the plate and cathode circuits respectively. Thus, a voltage of the same potential but of opposite polarity is developed in the two outputs. This charges condensers C_1 and C_2 in opposite polarities. (Condenser C_1 can be considered an extension of the plate-cathode tube capacity. It is part of the inherent phase-shifting network).

The filament circuit of the phase converter is omitted for simplicity. It may be readily seen, however, that while conducting, the diode is an effective low-resistance path from C_1 to C_2 . Thus, while the sync amplifier is passing a horizontal sync pulse the condensers C_1 and C_2 charge, right through the diode. Resistors R_1 and R_2 act as bleeding control returns to ground.

Due to the time constant of circuit components, condensers C_1 and C_2 are not fully discharged before the next sync pulse is applied to the input of the sync amplifier. Thus an effective d.c. is established within the circuit which may be measured say, at point "X." Since this is a balanced circuit, if incoming sync pulses are of equal amplitude, the voltage at reference point "X" would be zero.

A short digression is in order to explain the "phase converter" whose real work is yet to begin. The horizontal sync pulse has been rectified and it is ready to be mixed with the horizontal sweep pulse tapped off of the horizontal yoke (not shown). This latter pulse is the one developed by the local horizontal oscillator which is not shown.

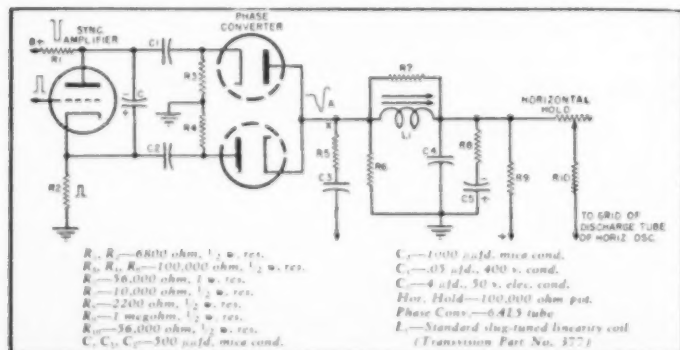
The essence of the mixing within the phase converter lies in the following reasoning. The horizontal oscillator circuit of the TV receiver is triggered by the horizontal sync pulse in normal operation. This "trigger" pulse rides on the modified saw-tooth sweep which leaves the horizontal output circuit and is impressed on the horizontal yoke. Naturally the question arises—Is it really doing all this?

The phase converter circuit is a checking and correcting device which answers that question. It examines the pure sync pulses stripped from the composite video signal and simultaneously examines the sweep pulses already corrected by that same sync, checking them against each other for accuracy.

Since these two pulses pass through the phase converter tube together to be rectified, conversion will take place, just like the converter in the common superheterodyne. Only it won't be a conversion to change frequencies. (The frequency difference will be in the order of a fraction of a cycle.) The comparison will be one of phase difference. Thus the name, phase converter.

No matter how sharply the circuits are tuned in superheterodyne converter stages, the resulting conversion (Continued on page 88)

Fig. 2. Schematic and parts list of Transvision's lock in circuit for TV receivers.



The MINI-RACK TRANSMITTER

Complete 100-watt, all-band c.w. transmitter which is housed in a miniature relay rack, 19" x 10". The front panel is aluminum, finished in grey crackle. The rack frame is made of 3/8" aluminum angle stock and self-tapping screws. The three decks, from top to bottom, are: final amplifier, the v.f.o. exciter unit, and the final amplifier power supply assembly.

By
**JOHN F. CLEMENS,
W9ERN**

Designed for clickless and chirpless keying, this compact, home-built transmitter is smaller than most of the present-day communications receivers.

THE modern amateur station invariably uses some form of variable frequency control. The current trend in transmitter design accents speed and flexibility of control but these advantages are usually obtained at an increase in complexity and bulk. After several attempts at transmitter layout along conventional lines, the author concluded that a standard relay rack occupied too much operating table space. Finally, the pictured layout evolved and proved quite satisfactory from the standpoint of operating convenience. The transmitter is constructed in miniature relay rack style. The front panels are ten inches wide and the three decks, final power supply, v.f.o. exciter, and final amplifier, total 19 inches high. The rack is eight inches deep. Thus the complete 100 watt, all-

band transmitter occupies only 8x10 inches on the operating table.

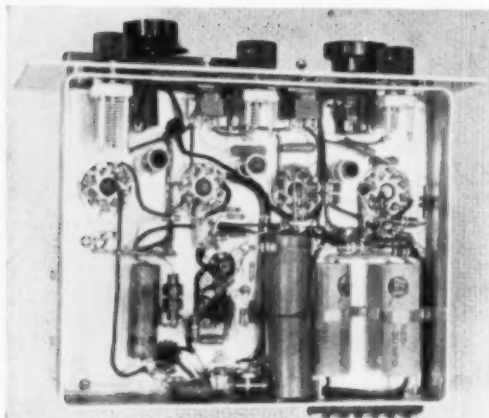
The absence of a transformer-type exciter power supply greatly facilitates compact construction. The voltage doubler power supply for the exciter uses selenium rectifiers and makes the exciter a completely self-powered, all-band, 15-watt transmitter. The voltage doubler power supply using vacuum rectifiers has never gained wide popularity among amateurs, due to its notoriously poor voltage regulation. Selenium rectifiers

tell a different story due to their extremely low resistance in the conducting direction. As a result, the voltage regulation is excellent. In the exciter, the key-up to key-down voltage change is from 295 to 270 volts when the current change is 40 to 130 ma. The power supply generates very little heat which is important since it helps in obtaining frequency stability.

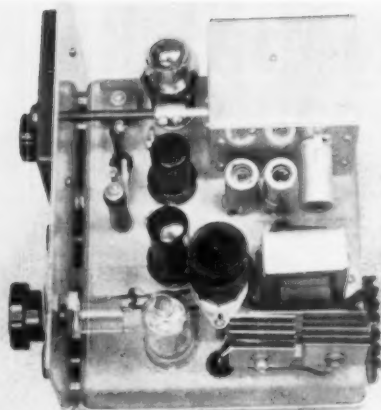
One objection to the transformerless power supply remains: the fact that one side of the power line is connected to the chassis. This need cause no difficulty if the operator is careful to insert the wall plug with the grounded side of the line connected to the chassis. If the transmitter is located some distance from any grounded object, e.g., on the second floor and not near a radiator, the grounded line needs little consideration since neither plug position can cause a shock. Of course, the safest procedure is to provide a good ground lead from the chassis to a water pipe and to be careful to insert the plug correctly. The single wire plug system with the ground lead may also be used.

The variable frequency oscillator uses a 6C4 or 9002 in the now-famous Clapp circuit. The tuning range is 1.7 to 2.0 mc. so that all the amateur frequencies from 3.5 to 29.7 mc. are covered. A great deal has been written recently about the advantages of the Clapp circuit so there is no need to review it here. One point should be mentioned in connection with the stability of the oscillator. If maximum dynamic stability is to be ob-

Coming Next Month
"THE MINI-RACK MODULATOR"
A 50-watt modulator designed as a companion unit to this transmitter.



Bottom view of exciter. The exciter chassis is provided with a cover which has been removed to show wiring. The three variable condensers tune 80, 40, and 20 m. doubler tank circuits.



Top view of exciter. The unit is a self-powered, 15-watt transmitter. The rectifiers are mounted with the fins vertical to aid cooling. The 2E26 plate coil socket is mounted on spacers.

tained it is essential that the oscillator coil have maximum "Q." This requirement necessarily imposes a limitation on the construction since a coil must have a diameter of at least two inches at this frequency if high "Q" is to be obtained. In addition, the shield around the coil should clear it everywhere by at least the coil diameter. It is apparent that the oscillator will become a bulky unit if these conditions are realized. The keying ability of the oscillator depends on the frequency-change versus plate voltage characteristic which we have referred to as the "dynamic stability." Dynamic stability is of only secondary importance if the oscillator is not keyed and is supplied from a voltage stabilized power source. The oscillator still retains the stability which accrues by virtue of the large capacities between grid and cathode, and ground and cathode so that thermal variations in tube constants and changes in load cause little effect on the frequency. It should be emphasized that where dynamic conditions are maintained constant by voltage regulation and by continuous, rather than keyed operation, the Clapp oscillator will be stable even though the coil does not have the highest possible "Q." This is the basis for the compact construction of the exciter. It was reasoned that the best oscillator keying would do no better than approach buffer keying and if back-wave effects could be eliminated the latter would be superior.

In order to provide a constant load for the oscillator the second stage is not keyed. It is coupled to the oscillator through a $1 \mu\text{fd}$. condenser. This loose coupling prevents reaction of subsequent stages on the oscillator.

A second 6AK5 is keyed by the blocked-grid system. The network of resistors and condensers in the keying circuit has been carefully proportioned to give excellent keying. From

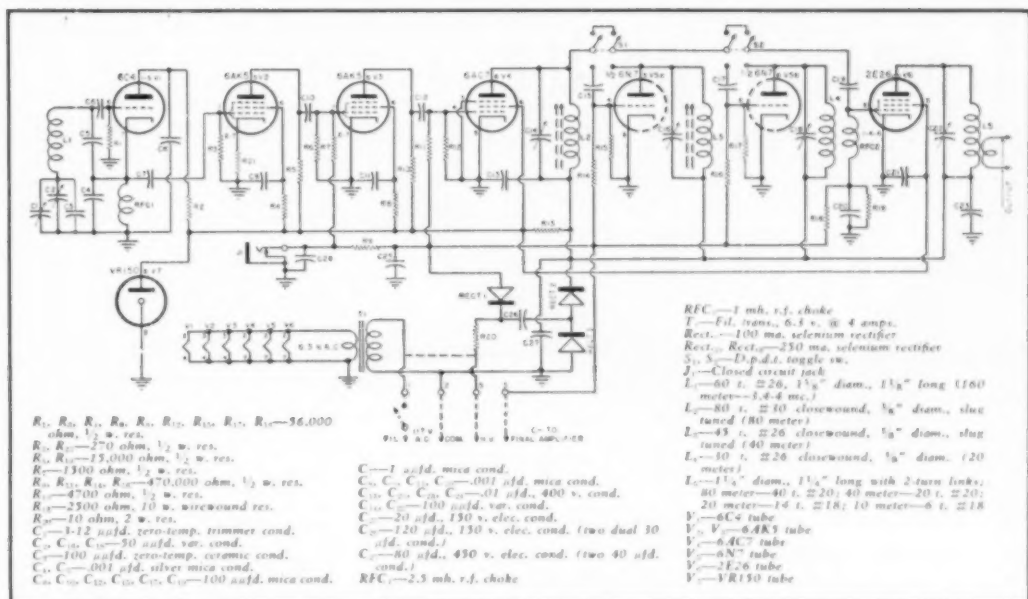
the diagram it can be seen that resistors R_1 , R_2 , and R_3 set the key-up bias. The voltage at this point, used to block the grid, should be no greater than necessary to completely cut off the tube or the stage will generate clicks by acting as a pulse-sharpening amplifier. This same rule applies to all the succeeding stages. Next, R_4 and C_1 form a time-constant circuit to round off the keyed characters with a slight lag and filter r.f. from the key leads. Third, the value of R_5 is made as low as possible to reduce phase modulation of the wave at high keying speeds which could cause a keying chirp or thump. Phase modulation might result from the variation of the impedance represented by R_5 in parallel with the input capacity of the 6AK5 as this capacity varies with the bias due to Miller effect. Since R_5 is quite low, the impedance of the combination is virtually unaffected by the changing capacitive component.

The second 6AK5 produces sufficient output to excite a 6AC7 80 meter doubler. Like all the following stages of the transmitter, this tube has cut-off bias applied from the bias supply. The method in which the bias is applied varies from the usual series fed system. The selenium rectifier bias supply furnishes 125 volts across the $20 \mu\text{fd}$. filter condenser. Since this voltage is considerably higher than is required by the exciter stages, voltage dividers are used to introduce the bias to each stage. In the 6AC7 stage, resistors R_6 and R_7 comprise this bleeder. When the key is up the cut-off bias is determined by the ratio of R_6 to R_7 . When the key is down the bias is almost entirely determined by R_6 alone, since the impedance of the path through R_6 and the bias supply is infinite by comparison. This method of applying bias has two advantages: (1) No high current bleeder is necessary, and (2) the self-regulatory character of grid leak bias is obtained. Al-

though an extra resistor is used in each stage, cathode bias resistors and bypass condensers have been eliminated. The final amplifier bias is applied in the more conventional manner from the VR tube with the exciter bias supply furnishing ignition potential. The five milliamperes drained from the exciter bias supply keeps the VR tube lighted when the key is up. Because of the extremely small current drawn from the bias supply, a single filter condenser is adequate.

It has already been mentioned that key click prevention demands low bias. A second requirement is that the bias on each stage be sufficient to completely cut off each tube when the key is up. This conflicting requirement is necessary if backwave radiation is to be prevented. While reasonable care in shielding the transmitter will reduce the radiation in the key-up position, the tube cut-off measure will give the final touch so that break-in operation may be used on the oscillator frequency. A vestigial signal may be heard in the receiver on the 80 and 40 meter bands but it is too weak to mask any other signal. This is a small price to pay for 100% clickless keying. It is possible to monitor the 40 meter band with the transmitter being operated on the same operating table and same band without trouble from clicks. An auxiliary lag circuit is used at the bug, consisting of a small "a.c.-d.c." type filter choke in series with the key and a $1 \mu\text{fd}$. condenser across the key.

The 80 meter tank circuit of the 6AC7 is tuned by the knob on the left below the v.f.o. dial. Ordinarily this control need only be touched if a frequency change is made from one end of the 80 meter band to the other. All three doubler tank circuits are low capacity, low "Q" circuits so that the tuning is not critical. Much simpler than ganged tuning, this system is just as satisfactory and the trans-



Circuit diagram and parts list covering the 15-watt, all-band exciter unit used in the Mini-Rack transmitter.

mitter is always ready to be peaked to the limit of its last ounce of output for a bit of choice DX.

Although the coil forms used in the exciter unit were home-built from bakelite tubing, an almost identical coil form is available from the Cambridge Thermionic Corp. It is the Type LS-3 and is supplied complete with a tuning slug. Since slug-tuning is used only on coils L_1 and L_2 , if the coil form for L_1 (20 meters) has slug-tuning, this must be removed before the coil is wound for this circuit.

Next to the 80 meter tuning control is the 80 to 40 meter bandswitch, an ordinary d.p.d.t. toggle switch. This method of doubler switching is not at all new but was revived after considerable experimenting with wafer and other types of bandswitches. It has the advantage that it is not necessary to backtrack in the wiring since the wiring progresses logically from stage to stage with a bandswitch occurring between the doublers. If possible, toggle switches of the molded bakelite type should be selected in preference to the laminated type. The r.f. losses in either type are quite small but the molded type has a more convenient terminal arrangement with all the lugs on the rear.

Functionally, this switch determines which tube receives the 80 meter signal; in the "up" position the 80 meter output is applied to the doubler stage while in the "down" position the 80 meter signal may be applied to the 2E26 grid. No power supply switching is necessary because of the cut-off bias on the unused tubes.

For 40 and 20 meter doubling, the

two halves of a 6N7 are used with a similar toggle bandswitch between them. Thus it is possible to drive the 2E26 grid with 80, 40, or 20 meter excitation merely by flipping the toggle switches. Due to the high μ of the 6N7, very little bias is required to cut off the stages and it is a very efficient doubler. It is operated well below its rating in driving the 2E26.

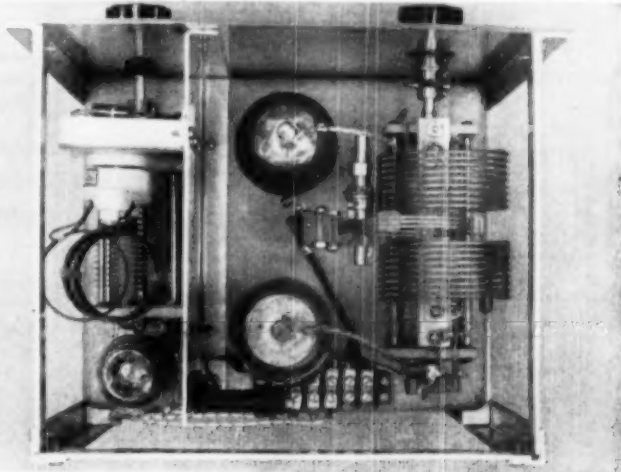
The 40 meter tuning knob is in the center of the lower row with the 20 meter tuning knob on the right. Be-

tween the 40/20 meter bandswitch and the 20 meter tuning knob is the key jack with the 2E26 plate tuning knob above it.

The principal design features of the 2E26 are wasted in the buffer application since the tube is designed for higher frequency operation. The double-ended construction keeps all the plate circuit components above the chassis but since the stage doubles on all bands except 80 meters, there

(Continued on page 114)

Top view of the final amplifier section used in the Mini-Rack transmitter. Push-pull 90's are used. The grid coil is mounted at right angles to the unit's plate coil in order to prevent self-oscillation which might be caused by magnetic coupling.



Small Capacity CONDENSER TESTER

By
T. A. BENHAM

Asst. Prof. of Physics
Haverford College

***This versatile, home-built test instrument will
measure capacities up to 90 μ fd. accurately.***

WHenever it is suggested that a ham build a circuit in which tuned elements must be carefully adjusted, the immediate reaction is, "How am I going to adjust all those circuits without having expensive trimmers all over the place?" This understandable reaction might prevent many interesting developments from materializing. Many of these adjustments could be made through the proper selection of a fixed condenser if there were some

convenient way of selecting the proper value. One suggestion would be to connect, temporarily, a variable condenser across the circuit, adjust for desired results, remove the condenser without disturbing its setting, measure its capacity, and then select a fixed condenser of the same capacity. This would imply that all hams have a large assortment of high grade fixed condensers on hand, but with the excellent bargains in these small capacity condensers which are still

available, this is not an unreasonable assumption.

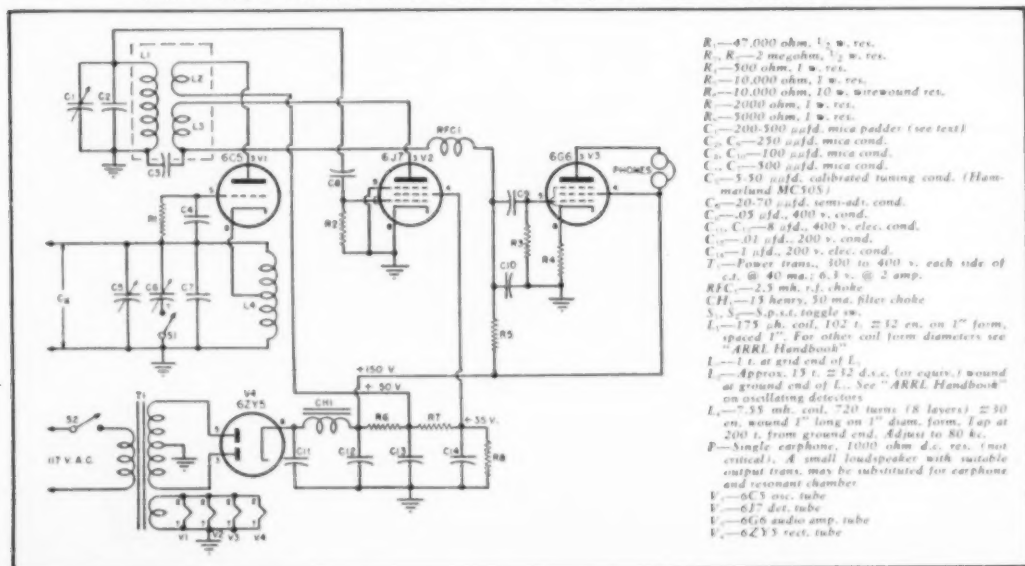
The instrument described in the following paragraphs makes the above suggested procedure feasible.

If an oscillator is built and tuned to a known frequency and the unknown condenser is then connected across the tuning condenser in the oscillator, the capacity of the unknown can be easily determined by reducing the capacity of the tuning condenser until the frequency has again been brought to the initial value. The unknown capacity is the difference between the two tuning capacities. All that is necessary is to have a tuning condenser whose capacity versus angle of rotation is known and a detector for determining when the oscillator has been returned to the initial frequency. The absolute capacity of the tuning circuit need not be known, only the change in capacity is required.

The first of these requirements was met by obtaining a small variable condenser which had a straight-line capacity versus angle of rotation. A Hammarlund MC50S high grade condenser, having a capacity range of 45 μ fd., was employed. The dial plate for this was marked off in nine equal divisions with each division being equivalent to 5 μ fd. In order to extend the range to 90 μ fd., a second adjustable condenser was connected across the first condenser through a single-pole, single-throw switch. If the capacity being checked is between 45 and 90 μ fd., it will be necessary to remove the second condenser by opening the switch and adjusting the calibrated unit. If the unknown

(Continued on page 146)

Schematic diagram of condenser tester. A straight-line capacity taper variable condenser should be used.



SIMULATING TV INTERFERENCE PATTERNS

By
E. G. LOUIS

The ability to recognize trouble by the type of pattern is an asset in servicing video receivers.

WHEN television "comes" to a town or city, practically every local radio technician who has not already been studying television will try to get all the information possible within a few short days or weeks. By reading articles, studying manufacturers' service manuals, and, in many cases by actual experimentation (building sets from kits, etc.), he will try to acquaint himself with the principles and practices of the new (to him) field.

It is one thing, however, to read about a condition or circuit, and quite another to actually work on the circuit, or to work on a set with a given defective condition.

One of the most valuable assets that a TV technician can acquire is the ability to recognize trouble by the type of pattern (or lack of pattern) obtained on the screen of the TV receiver. Such an ability enables the technician to reduce servicing time by making his diagnosis much more rapidly, and enables him to isolate the defective section of the TV set much more quickly.

Therefore, for a radio technician or student first learning television, or even for the man with some experience, it is often desirable for him to spend a few days experimenting with a TV receiver known to be in good operating condition. Common defects can be introduced, and their effect on set operation noted. A leaky coupling condenser might be simulated by shunting a condenser with a high value resistance. An open condenser may be simulated by either opening the lead, or by substituting a much smaller condenser. Low emission tubes may be simulated by placing a small resistor in series with the filament lead in order to drop the filament current.

By carrying out this program, the technician can soon learn what symptoms to expect from the more common defects, and is thus in a better position to go right to the source of a complaint.

Some complaints are not too easy to simulate. Interference, for example, apparently cannot be duplicated un-

der test conditions unless an actual interference condition exists. However, a simple technique has been worked out by which the effects of certain types of interference on the screen may be easily shown. By actually demonstrating the patterns obtained, the technician will be in a better position to recognize the cause and so take corrective steps.

The only item, besides a television set, needed for demonstrating some of the more common TV interference test patterns is an ordinary AM signal generator . . . preferably one that can supply either an audio tone, an unmodulated r.f. signal, or a modulated r.f. signal, and in which the operating frequency can be easily varied; in other words, the type of signal generator found in the majority of service shops in the nation.

The signal generator is simply connected across the video second detector load resistor as illustrated in Fig. 1E. It is assumed that the signal generator has a built-in d.c. blocking condenser in series with the "hot" lead. If not, or if there is any doubt, then a .01 μ fd, 600 v. paper condenser should be connected in series with the "hot" lead.

Both the signal generator and the TV receiver are now turned on. If a station is on the air at the time the experiments are to be carried out, then a program can be tuned in so that the "interference" pattern will appear superimposed on the program picture . . . such as would be the case if actual interference trouble were encountered. But even if a program is not available, the basic patterns can still be shown to advantage.

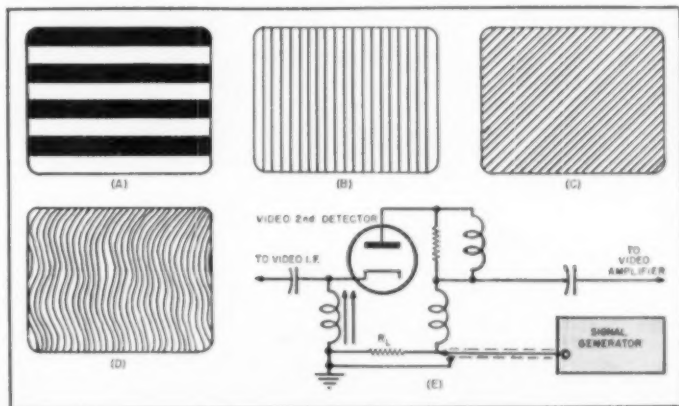
If a program is not being received, adjust the brilliancy and contrast controls on the TV set so that a raster appears on the screen. Then adjust the signal generator to deliver an audio signal.

Since the frequency of the audio signal will be far below that of the horizontal sweep, several lines at a time will be made brighter and darker by the audio signal, resulting in "bars" horizontally across the TV screen as shown in Fig. 1A. If a program is being received, these bars will be superimposed on the picture.

These are the well known "sound bars" that may result from misadjustment of the fine tuning control or local oscillator in a TV set, or from misalignment in the video i.f. stages. Whenever bars of this type (horizontal) appear on a TV screen, you can be pretty sure that an audio signal is getting into the video section.

(Continued on page 144)

Fig. 1.





Modern TELEVISION RECEIVERS

Part 23. A discussion of horizontal a.f.c. systems that combine economy of design with good stability.

1950 TV models—(counter-clockwise) Arvin Model 4080 TV (8½"); RCA Model TC-124 (12½"); Stromberg-Carlson Model TC 125 LA4 (12½"); G.E. Model 12C109 (12½"); RCA Model T-100 (10"); Starrett "Sam Houston" (12½"); and G.E. Model 1076 (10") in plastic cabinet.

By

MILTON S. KIVER

THE television industry, although very young in years and experience, is already fiercely competitive. Any economy in design which will permit the cost of a set to be lowered without appreciably lowering the standards of set operation is highly desirable. The previously discussed sine wave and saw-tooth wave a.f.c. systems required three and two tubes respectively. The pulse width a.f.c. system, about to be examined, requires only one tube, a relatively inexpensive 6SN7.

The circuit schematic, shown in Fig. 1, consists of a single control tube, a long time-constant filter, and a blocking oscillator. The 6BG6G horizontal output tube is added to the diagram because part of its output voltage is fed back to the control tube. Basically, the horizontal oscillator is a free-running oscillator and discharge circuit. It does not receive the incoming

pulses directly, but, should its frequency differ from that of the pulses, the control tube, V_c , will alter the negative bias on the grid of the blocking oscillator and thereby change its frequency. It can accomplish this because the cathode resistor R_k of the control tube is common to the grid of the blocking oscillator. The incoming sync pulses, positive in polarity, are received by the grid of V_c through a 120- μ fd. condenser. This same grid also receives a pulse from the horizontal output transformer, plus a parabolic wave from the output of the horizontal oscillator (V_o) itself. The pulse from the output transformer and the parabolic wave from the horizontal oscillator form a combined wave, which then reacts with the incoming sync pulses to maintain the blocking oscillator on frequency.

Fig. 1 illustrates the shape of the various voltages reaching V_c . The wave obtained from the output of V_o is originally a saw-tooth wave, but it is converted into a parabolic wave by the 150,000 ohm resistor and condenser C_1 before reaching V_c . The pulse which appears at the secondary of the horizontal output transformer is modified somewhat in form by an integrating network consisting of a 560,000 ohm resistor, a 5 μ fd. condenser, and C_2 . The shape this pulse finally assumes is shown in Fig. 1.

The combined wave is specifically

designed to have fairly steep sides (see Fig. 2) in order that any difference in frequency between the blocking oscillator and the incoming sync pulses will have a marked effect on the circuit. Here is how this occurs.

A portion of the bias from the blocking oscillator is applied to the grid of the control tube and is sufficient to keep the control tube cut off except when the incoming sync pulse is high on the slope of the grid waveform (the combined wave mentioned previously) as shown in Fig. 2A. If the blocking oscillator changes phase so that the pulse arrives at a time when it is down the slope, the length of time that V_c conducts will diminish. This is indicated in Fig. 2B by the narrow width of the waveform extending above the cut-off point of the tube V_c . On the other hand, if the blocking oscillator frequency changes so that the sync pulse arrives at a time when it is closer to the top of the combined wave (Fig. 2C), then the plate conduction time of V_c will increase. When the control tube conducts, C_1 and C_2 in its cathode circuit will charge to a d.c. potential proportional to the length of time that current flows through the tube. This d.c. potential is applied as a bias to the grid of the blocking oscillator, thereby altering its frequency and tending to bring it back into line.

A long time-constant filter to

RADIO & TELEVISION NEWS

achieve an averaging effect is placed in the cathode leg of V_1 and consists of R_1 , R_2 , and C_1 . Note, however, that these are not the only components in this portion of the circuit. C_1 (a .02 μ fd. condenser) and R_3 (an 8200 ohm resistor) are also present and their purpose is to provide better sync control of the oscillator by permitting a small component of the sync pulse to reach the grid of the oscillator tube, V_2 . The combination of the long time-constant filter with the short time-constant filter thus presents to the oscillator a large d.c. component (due to the averaging effect of R_1 , R_2 , and C_1) plus a much smaller a.c. component (due to C_1 and R_3).

There are five controls associated with this circuit and they function as follows: The blocking oscillator transformer, L_1 , is slug-tuned to permit coarse adjustments in oscillator frequency. C_2 , connected across the resistor common to the control tube and blocking oscillator, can provide fine adjustments in frequency. The horizontal hold control will affect the plate voltage of the control tube and, in this manner, the amount of voltage developed across R_1 . This is the only front-panel control of the group. C_3 is part of a voltage divider network that controls the amplitude of the waveform on the grid of the control tube. C_4 will therefore control the point at which V_1 starts to conduct. Finally, C_5 is part of a capacitance voltage divider and regulates the amount of voltage reaching V_2 . It partially controls the width of the picture and partially the linearity of the left-hand side of this image. An additional linearity control located at a subsequent point in the horizontal sweep system regulates the over-all horizontal linearity.

Several components of the oscillator and control circuits have special coefficients or characteristics and, in case of failure, should be replaced only by an exact duplicate. R_4 is a special resistor capable of stability of 1 per-cent or better. R_5 is a high negative coefficient resistor to compensate for warm-up drift. It is mounted within about $\frac{1}{4}$ inch of the power transformer and chassis for good heat transfer.

Adjustment of Pulse-Width A.F.C. System. When the pulse-width a.f.c. system is operating properly, it should be possible to perform the following test on it. Permit the set to warm up for about 5 minutes and then tune in a station with the station selector control. The picture should be locked-in. Now, rotate the horizontal hold control, R_1 , over its entire range. It should be possible to hold the picture in sync throughout three-fourths of this range. Next, place the control at mid-position, switch to another channel and back again. The picture should immediately lock into synchronization. It will be found when switching stations, that the picture will lock in throughout more than half the range of R_1 , although generally

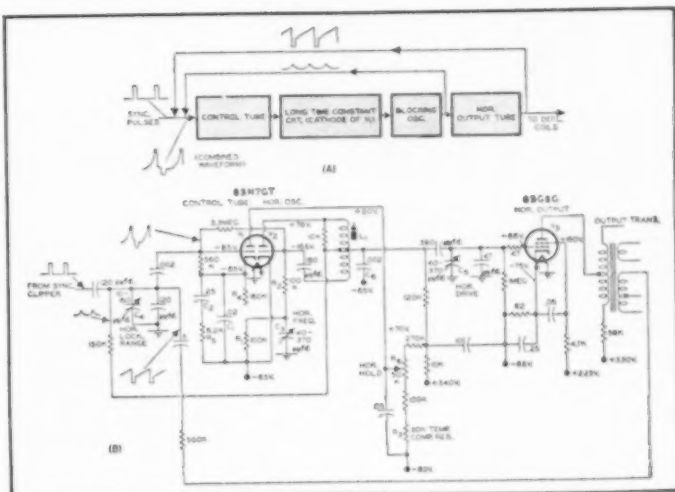


Fig. 1. Schematic diagram of the pulse-width a.f.c. system. The waveforms are shown as to shape only and are not indicative of their relative size.

not when this control is set at either extreme position.

If it is found that the picture tends to slip out of synchronization or that after switching stations, the picture does not immediately lock-in, the following adjustments should be made.

Adjust the iron core of L_1 for a steady picture, with the front panel horizontal hold control at mid-position. Note whether the picture remains locked-in as R_1 is rotated through half its range. Set the hold control to its mid-position, switch to another channel and then back again. If the picture does not remain in sync, back off the horizontal locking trimmer, C_2 , to 2 to 2½ turns from tight. Next, turn the horizontal hold control to the extreme counter-clockwise position and back off on the horizontal frequency trimmer, C_3 , until the picture tends to slip to the right, then turn the hold control clockwise until the picture locks in. When this has been done, it should be possible to switch stations or turn the set on and off without losing synchronization.

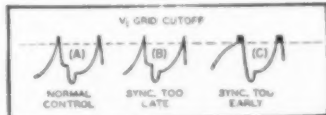
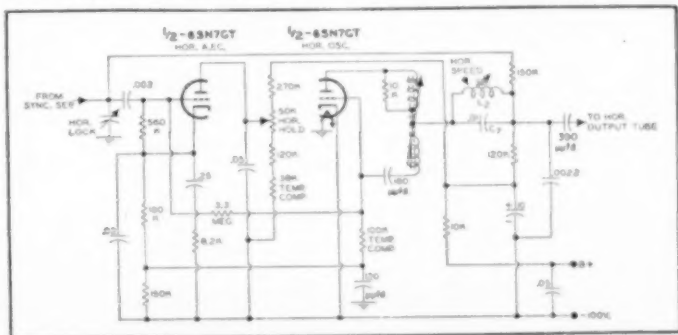


Fig. 2. Horizontal control waveforms. Area above dotted line is portion of waveform effective in controlling oscillator.

A slight modification of the circuit of Fig. 1, which is frequently seen, is the circuit shown in Fig. 3. The horizontal frequency trimmer condenser, C_2 , has been replaced by a fixed condenser and a parallel resonant circuit consisting of C_3 and L_1 has been placed in series with the charge and discharge condenser, C_4 . This is a stabilizing circuit, designed to improve the stability of the oscillator and control circuits. With these additional components in the circuit, the adjustment procedure is as follows:

1. Set the horizontal hold control to the full clockwise position.
2. Adjust the horizontal lock

Fig. 3. Schematic diagram of a variation of the pulse width a.f.c. system.



By
SAMUEL FREEDMAN

Elimination of RADIO INTERFERENCE By OFF-FREQUENCY INVERSION

*Improvement in receiver selectivity
may be obtained with this new circuit.*

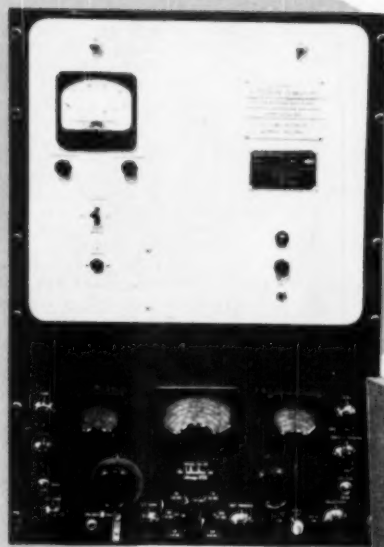


Fig. 1. First heterodyne eliminator using off-frequency inversion. Originally built for the FCC, it is now in the Commission's Instrument Museum.

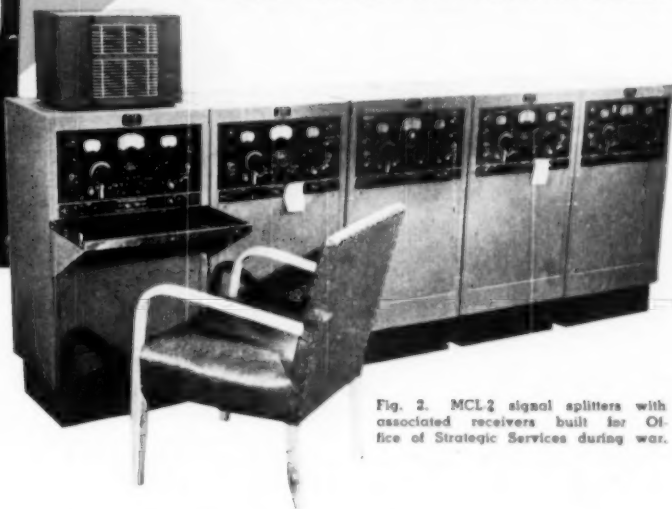


Fig. 2. MCL-2 signal splitters with associated receivers built for Office of Strategic Services during war.

THE first improvement in radio receiver selectivity in twenty years—since James Lamb's invention of phasing control to permit the use of crystal filters—is the asymmetrical off-frequency inverter type of heterodyne eliminator developed by James L. A. McLaughlin of LaJolla, California. It is an outgrowth of wartime developments undertaken in his laboratory for the Radio Intelligence Division of the Federal Communications Commission and for the Office of Strategic Services (OSS).

At the outbreak of World War II, the Federal Communications Commission had the problem of monitoring and receiving Japanese signals. Spoken Japanese contains very high frequencies not encountered in spoken English. The syllables of the Japanese language are as much a part of the meaning or interpretation of the word as are the syllables themselves. Where English, as spoken by Americans, can be quite intelligible with a maximum

modulating frequency of 3000 c.p.s., our translators might require as much as 5000 c.p.s. to get the gist of material in Japanese.

During the search for more suitable radio receiving apparatus to cope with this problem, an FCC engineer obtained Mr. McLaughlin's original model of the heterodyne eliminator as shown in Fig. 1. This signal splitter, or heterodyne eliminator, was designated the Type MC-1. This was later modified to become the first automatic heterodyne eliminator. The instrument is now in the Instrument Museum of the Federal Communications Commission in Washington and represents the first unit of its type ever constructed.

This early model was used in conjunction with a standard *Hallcrafters* Model SX-28 receiver. On the basis of

extensive tests these units were ordered for all of the primary monitoring stations of the Radio Intelligence Division.

When the Communication Branch of the Office of Strategic Services was established in 1942, it was faced with the task of copying signals through terrific jamming. Similar apparatus for anti-jamming purposes was ordered and evolved as the MCL-2 shown in Fig. 2. These units were used extensively during the war wherever the jamming problem was encountered.

By the end of the war a third type of heterodyne eliminator had been developed. Known as the MCL-3 this apparatus did not require any modification of the receiver. An internal view of this model is shown in Fig. 4. With this unit if interference was encountered on one side of a mean fre-

worthwhile improvement along this line.

Fig. 3 is the circuit diagram of the MCL-4 heterodyne eliminator or signal splitter together with a complete parts list. Fig. 5 is an elementary block diagram of a heterodyne suppressor of the off-frequency inverter type suitable for unmodulated reception.

Let us assume that a desired signal of 455 kc. is present, for example a code signal from the i.f. of a receiver, and that an interfering signal of 455.8 kc. is also present. As shown, two fixed oscillators are used, separated from the desired signal by 1 kc. Thus, if the 456 kc. oscillator is used, the desired signal will be converted to a frequency of 1 kc. and the undesired signal to 200 cycles. This mixed signal is sent through an asymmetrical off-frequency filter with a center frequency of 1000 cycles. This filter will permit a 1000 cycle signal to pass through but attenuates all signals below 1000 cycles very sharply. Thus, in this case, the desired 1 kc. signal would pass through while the undesired 200 cycle interfering signal would be attenuated 60 db.

If the 454 kc. oscillator is used, the desired signal again becomes 1 kc. and the undesired signal 1.8 kc., which will be attenuated 25 db. in the filter. Thus, either oscillator may be switched on, the one giving the highest attenuation of the undesired signal being the most satisfactory operating position in most cases. This is true whether the unwanted signal is higher or lower in frequency than the desired carrier.

Fig. 7 is a simplified block diagram of the heterodyne eliminator for either voice or code reception. It will be noted that two off-frequency inverters are used, one feeding the 50 kc. asymmetrical off-frequency filter and the other the 1 kc. filter previously described. The 50 kc. filter is of the high-pass type, cutting off very sharply below 50 kc., and the off-frequency inverter is switched so that the undesired signal is below 50 kc., and is thus highly attenuated. For example, a carrier 1.5 kc. off center may be down as much as 100 db. on phone-type signals. Even greater attenuation is possible with code signals due to the action of the second off-frequency inverter and filter.

Normally, the MCL-4 signal splitter is intended for use with any communications receiver having an intermediate frequency of approximately 455 kc. If the i.f. is other than 455 kc., it is only necessary to change the two local oscillator crystals to 50 kc. above and 50 kc. below the appropriate i.f. setting. No realignment or circuit changes are required in the associated receiver. The unit connects to the receiver through a small coaxial cable, the end of which has an insulated loop. This loop is placed over the plate pin of the first i.f. amplifier tube and the tube is replaced in its socket. The signal splitter has been designed for con-



Fig. 4. Type MCL-3 heterodyne eliminator using tuned transformers instead of filters. This eliminator may be used without modification of the associated receiver unit.

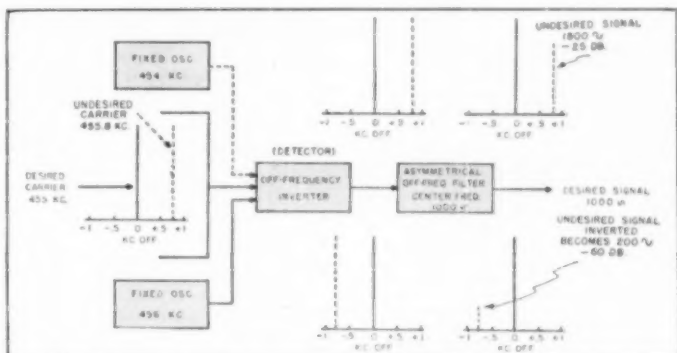


Fig. 5. Elementary block diagram of a heterodyne suppressor of the off-frequency inverter type which is suitable for the reception of continuous wave signals.

Fig. 6. Type MCL-4 signal splitter built for U. S. Coast Guard radio stations.



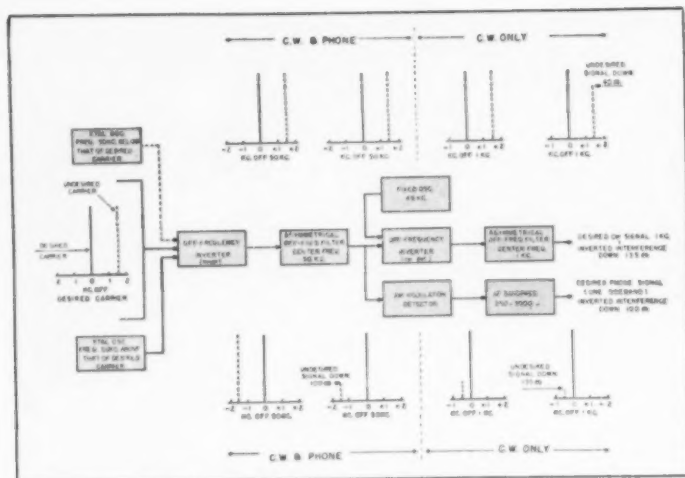
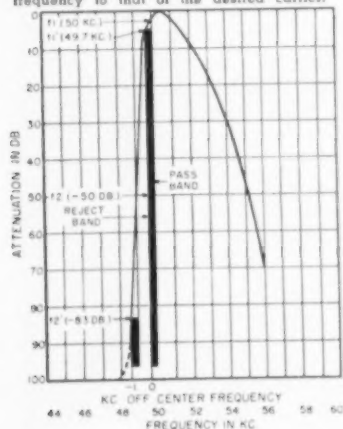


Fig. 7. A simplified block diagram of the Type MCL-4 signal splitter.

tinuous operation and has a power drain of 70 watts from a 105/125 volt, 60-cycle, single-phase source. The audio output of the instrument at 5% harmonic distortion is approximately

Fig. 8. Asymmetrical selectivity curve of the MCL-4 signal splitter. As illustrated, the desired signal will be at 50 kc. Should an undesired signal lie 1 kc. removed (51 kc.) there would exist a heterodyne beat note of 1000 cycles which would be disagreeable. By using the frequency inverter feature, 51 kc. will be changed to 49 kc., while the desired signal remains at 50 kc. The undesired signal will be attenuated 50 db. Should an unusually strong signal and greater attenuation be required, a shift of but a few hundred cycles in tuning will provide an increase in attenuation of the desired signal. The solid line at 50 kc. is 300 cycles wide. Should greater attenuation be desired, the operator shifts his tuning. The desired signal is now 49.7 kc. (f.) instead of 50 kc. (f.). The interfering signal, f. (49 kc.) has now been shifted 300 cycles to position f. showing an increase of 33 db. attenuation (-83 db.) thus affording extreme selectivity to heterodyne interference lying very close in frequency to that of the desired carrier.



two watts. On c.w. reception 4 to 5 watts output power can be achieved without noticeable distortion.

A signal that will drive the receiver to full output will develop a voltage across the primary of the i.f. transformer (connected to the plate of the first i.f. tube) sufficient, when coupled through the capacity loop, to drive the signal splitter to approximately full output. If this capacity loop is placed around the pin of the second i.f. tube instead of the first, serious overloading of the signal splitter will result. This overloading could seriously impair the instrument's ability to reject heterodynes. For this reason, it is necessary that the capacity loop be coupled to the plate of the first i.f. tube.

With regards to phone-type signals, this system takes advantage of normal double sideband modulation. The fact that intelligence is duplicated on both sides and a carrier which can produce a beat note lies within one band, the system permits cutting off that whole band without losing the demodulated intelligence since it is also present on the other sideband. In such cases where the interference is of excessive magnitude in both bands, no further improvement can be made. This has led to investigations and further development of an improved communications system. This development now forms the basis of new patent applications which are as yet not ready for release to the public. It involves improved forms of modulation which permit an interfering carrier lying within a single sideband of intelligence to be handled with as much ease as the present systems requiring two sidebands.

In the case of professional c.w. code reception, the desired c.w. signal becomes a beat note of 1000 cycle bandpass filter in the audio circuit and the fact that the b.f.o. is fixed at 49 kc. In Fig.

8 it may be noted that the image frequency will be 48 kc. (derived by 49 kc. minus 1 kc. beat note) while the desired signal will be 50 kc. (49 kc. plus 1 kc.). In this example, it means that the undesired signal will be over 100 db. down. Fig. 8 shows the increase in attenuation to low frequencies that a slight detuning of the desired carrier achieves (50 kc.) toward the cut-off side. The left hand edge of the solid line at 50 kc. indicates a frequency shift of the carrier of approximately 300 cycles. At this point the carrier will be down 5 db. The bottom of the curve illustrates the increase in attenuation this small frequency shift gives a signal 1 kc. removed from the desired carrier, 33 db. greater attenuation has been realized. Frequencies closer to the carrier than 1 kc. will receive proportionate improvement in attenuation. Frequencies below the voice range are satisfactorily attenuated in the a.f. amplifier.

Even though the undesired signal is over 100 db. down it does not mean that the beat produced will be of this value since it is necessary to take into account the peculiar action of detectors. The detector is working as a square law detector on a weak signal and a linear detector on a strong signal. In this instance, the beat is proportional to the b.f.o. and the weak signal where in the case of the linear detection the signal is proportional to the weaker of the two mixed. In practice, it has been found that the beat note's actual measured attenuation is in the order of 80 db. This is sufficient attenuation for good reception of the desired signal. The theory of detection also applies to a crystal filter. For example, there might be many curves which show an attenuation of 60 db, whereas the beat note attenuation actually may not be more than about 40 db. This explains the disparity between theoretical crystal filter selectivity curves and those encountered in practice.

Fig. 10 is a block diagram of the automatic version of the anti-jamming or heterodyne eliminator which is similar to the apparatus shown in Fig. 1. A frequency discriminator "senses" the interference and operates the heterodyne (heterodyne automatic) switch to cut out the malicious interference automatically. It can perform this function automatically at any required rate even where FM jamming is taking place. It was developed during the war for use by radio intelligence groups which encountered this type of interference.

The effect of a drift in frequency of the receiver's local oscillator is not important. The operator, in practice, is fighting interference all the time and adjusting controls. The amount of drift present in any brief period is not too great.

The I.F. mean frequency of 455.5 kc. normally employed is supposed to take care of the fact that most receivers use either 455 or 456 kc. The I.F. is un-

important because 455 or 456 kc. is actually wide-band amplification compared to the selectivity of the signal splitter. Radio receivers are considered good when their i.f. stability is $\pm 2\%$. The same holds true for crystal filters when they are ± 10 kc.

Unlike most accessory items, the MCL-4 signal splitter reduces rather than increases the complexity of operation. For example, in the case of c.w. reception without this accessory, an operator trying to receive through interference may have to adjust the volume control, tuning control, crystal phasing control, b.f.o., etc. When the MCL-4 unit is employed, the entire process of shifting from the interfering side to the clear side of the mean frequency is automatically and instantly achieved by means of one off-frequency inverter toggle switch. The operator does not have to fuss with controls and lose time as well as signals. He quickly determines which side has the minimum interference and concentrates on that side. When a heterodyne is picked up, it is tuned in for maximum on the receiver. Then, by throwing the toggle switch, it is automatically cut out. It is actually easier to tune with a heterodyne than without. When no heterodyne is present the procedure is to tune by ear to the best response and throw the off-frequency inverter switch to the cut-off side.

Referring to Fig. 6, the front panel controls from left to right are: pilot light which comes on when adjacent toggle switch is in the "on" position; the off-frequency inverter triple-throw toggle switch with the top position "-A-" to invert with middle position, the middle position "+B-" to invert with top position, while the down position is labeled "Test" for precise tuning. In the "Test" position, both oscillators are employed which produces two signals moving in opposite directions as the receiver is tuned. The difference between the two signals is heard as a beat note. The correct position will be indicated at zero-beat; the audio gain control out of the unit; a triple-throw toggle switch with the top position for "AM Phone" reception the middle "CW" position is broad c.w. without the 1000 c.p.s. filter, and the bottom "Sharp" position for sharp c.w. with the 1000 c.p.s. filter; and phone jacks. If it is desired to feed both audio output of the receiver and the signal splitter to a common speaker or line, a patch cord should connect from the "Phones" jack of the receiver to the "AF Input" jack on the signal splitter. By turning down the audio gain on the signal splitter and bringing the gain up on the receiver, normal operation of the receiver is permitted. When the audio gain of the receiver is turned off as far as it will go and the gain of the signal splitter is brought up to operation level, the heterodyne elimination action of the signal splitter becomes possible.

There has been a tendency for per-

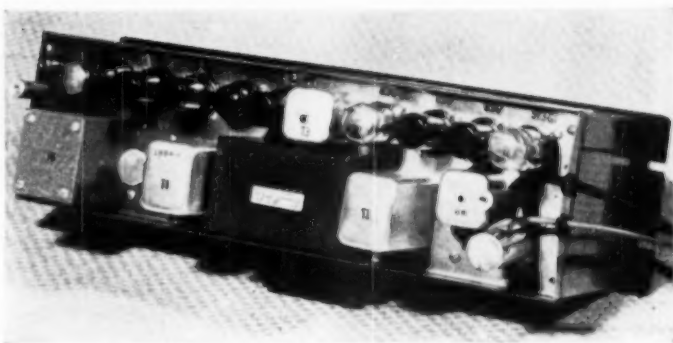


Fig. 9. The tube and transformer layout of the MCL-4 signal splitter.

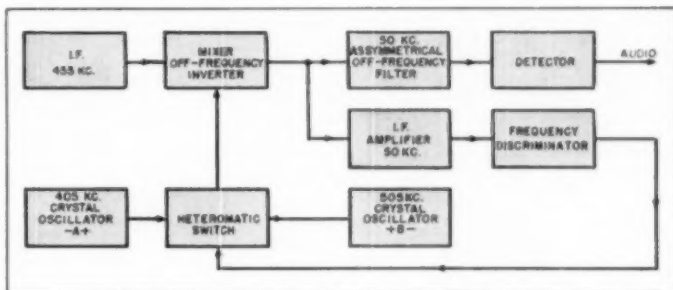


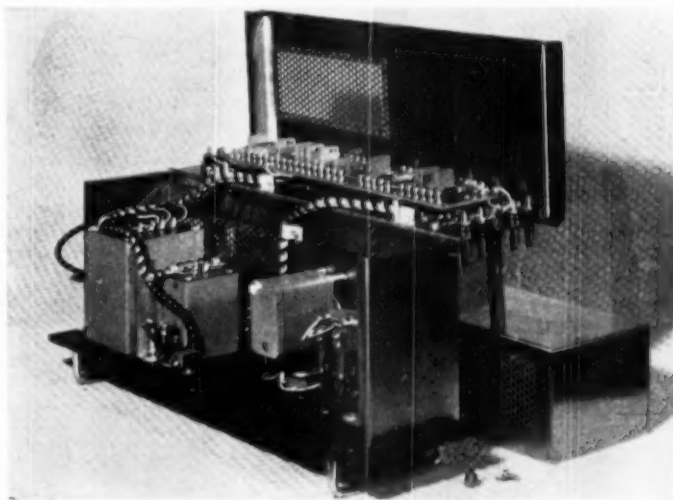
Fig. 10. Automatic version of anti-jamming or heterodyne eliminator.

sons operating this unit for the first time - confuse it with single sideband transmission even though recognized as an off-frequency inverter. They reach this conclusion because the inverter selects the best sideband. It is actually a sideband selector functioning with either single or double side-

band receivers. When used with a single sideband receiver, it performs no useful function other than its inherent selectivity. In the case of c.w., which has no sidebands, the asymmetrical (i.e., unsymmetrical) response of the system permits the off-frequency in-

(Continued on page 154)

Fig. 11. Interior view of MCL-4 signal splitter opened for inspection.



AROUND THE CLOCK WITH SHORT-WAVE ENGLISH NEWSCASTS

0000	LOCATION	CALL	FREQ.	EST	LOCATION	CALL	FREQ.	EST	LOCATION	CALL	FREQ.
(0000)	Manila	DZHH	9.640		London (ES)	GRO	8.180	0320 (BO)	Melbourne	VLRR	6.150
(I-NS)	Johannesburg	IV	4.800			GSX	6.060		(ABC)		
(I-NS)	(SABC)		4.373		Melbourne	VLRR	6.193		Wellington	ZL4	15.280
	Cape Town	III	5.880 A	0120	(SBC)				(To Pacific)	ZL3	11.780
	Proterea	ZRB	9.110	0130	Wellington	ZL4	15.280	(SO)	Saltisbury	ZR4	9.580
	(SABC Relay)	ZRB	6.2101		(BBC De-)	ZL7	6.080	0345 (SO)	Saltisbury	CHOL	11.720
	Buenos Aires	LRY	9.455 V		ayed Relay)				(CBC-To Pacific)	CKLO	9.830
	(SRI-To NA)				Rangoon		9.543	0355 (NB)	Melbourne	VLH3	9.580
	Los Angeles	KCBF	19.310	(NM)	London (Radio	GSN	11.820		(ABC)	VLQ3	9.580
	(AFRS-To Pacific)	KWIX	9.570		Newsworld	GRH	9.825		(ABC)	VLM	4.917.5
	Edmonton	KCBA	6.140		(To Pacific)	GRX	9.580	0400	Melbourne	VLH3	9.580
	Calgary	CFVP	6.030			GSW	2.330		(ABC)	VLRR	6.150
(BO)	Vancouver	CKFX	6.080	0145	Wellington	ZL4	15.280		Parth (ABC)	VLW3	11.830
	Toronto	CFRX	6.070		(SBC Relay	ZL3	11.780		VLX3	9.610	
0015	Melbourne (RA-				Radio News		6.035		ZKX2	9.670	
(NSAT)	(To W. NA)	VLBB	21.540	0200	London (GOS)	GSH	21.470		Brisbane (ABC)	VLQ3	9.560
(NSAT)	(To W. NA)	VLCC	17.840			GSV	17.810			VLM	4.917.5
	(To Africa)	VLGG	15.320			GRA	17.715		Sydney (ABC)	VLH2	6.080
	(To W. NA)	VLAA	15.315			(Via Ft. Morse)			by ABC)	VLTS	7.280
	Hong Kong	ZBW3	9.525 V			GBO	18.180		Kure (BFOS from ABC)	WLKS	6.105
0030	Brasaville					GSF	15.140		Melbourne	VLAA	15.280
	(To Europe)		11.972			GWG	15.110		(RA-To Pacific)	VLCA	15.310
	(To Africa)		9.873			GSC	9.580		Forces, Japan, Asia, N. Pacific)	VLB4	11.880
	(To Middle East)		7.400			GSB	9.510			VLG10	11.780
	(To Africa)		9.002		Malta (FBS-BBC Relay)		6.140				
(NB)	Saltburg (BDN)		6.024		Los Angeles	KNBX	15.250		Cebu	DYH2	6.140
	Toronto	CFRX	6.070		(AFRS-To Pacific)	KWID	11.900		Los Angeles	KWIX	11.860
0032	Buenos Aires	LRY	9.455 V			KCBF	11.810		(AFRS-To Pacific)	KCBF	9.700
0100	(SRI-To NA)					GRX	11.730			KWID	9.570
	London (GOS)					KWIX	9.570			KCBA	6.120
		GSO	15.180		Edmonton	KCBA	6.120		New York (VOA-To Far East)	KCEX	11.730
		GSF	15.140		Vancouver	CKFX	6.080			KNBR	9.515
	(To Pacific)	GSN	11.820		Melbourne	VLR	9.540			KNBI	6.185
		GSID	9.580		(ABC)				(Via Honolulu)	KRHH	9.650
	(To Pacific)	GRH	9.825		Lahore (Karachi Relay)		6.075		(Via Manila)	II	15.310
	(To Pacific)	GRX	9.690		London (ES)	QWT	9.675				
		GRY	9.600	0210		QWJ	9.525				
		GRSC	9.580	0215		QWN	7.280				
	(To Pacific)	GSB	9.510			GSU	7.260		Tokyo (AFRS)	JKK	6.015
(NB)		GSW	7.230			GWL	7.210		Berne (To Pacific)	HER6	15.305
	Singapore (Radio)	GSJ	6.110			GRO	6.180	0405		HER5	11.865
(BO)	Malaya, Blue Network)		7.220 V			GRW	6.150			HE15	11.715
	(Via Kuala Lumpur)		6.135			GSA	6.050		Saltisbury	ZEA	6.000
	Malta (FBS-BBC Relay)		6.025		Berne (To Pacific, Far	HER6	11.865	0440 (NS)	Saltisbury	ZEA	6.000
					Lake Success (UN Via VOA)	KNBA	9.700	0500	Saigon (Radio France Asia)	FZS4	11.780
	Vancouver	CFRX	4.965	0230*		KNBI	6.080	(NW-S) (NS)	Manila	DZH3	9.505 A
	Edmonton (CBC Relay)	VED	8.265	(NM)	(Via Honolulu)	KRHO	17.800		DZH6	6.030	
	Melbourne (ABC-BBC Relay)	VLR	9.540		(Via Manila)	II	15.330		Manila	DZH7	9.748
	Perth (ABC-BBC Relay)	VLW3	11.830		Colombo	ZOI	4.897 V	(NS)	Saltburg (BDN)	PHJ	21.480
	BBC Relay)	VLX3	9.610	0245	Vancouver	CKFX	6.080		Hilversum (To Pacific)	PHI	9.775
	Brisbane (ABC-BBC Relay)	VLQ3	9.680	(SO)	Saltburg (BDN)		9.533 V		PGD	15.220	
	Sydney (ABC-BBC Relay)	VLM	4.917.5		Delhi (AIR-To W. Europe)	VUDE	21.510		KWIX	11.860	
		VLH3	9.500			VUDT	17.830		KCEB	9.700	
(I)	(Via Ft. Moresby-ABC)	VL77	9.520			VUD3	17.760		(Los Angeles (To Pacific)	KCEI	9.670
	Johannesburg	III	4.895			VUD9	15.280			KWID	9.570
	(SABC-BBC Relay)	IV	4.800			VUD11	15.190	0515		KCBA	6.120
	Cape Town	III	5.880 A			VUD4	9.630	(NSS-M) (Daily) (NS)	Bangkok	HSSG3	9.786 A
	(SABC-BBC Relay)				Bombay (Delhi Relay)	VUB3	7.240		Manila	HSRPD	6.240 A
	Calcutta				(Delhi Relay)	VUC3	7.210		Port-of-Spain	VF8D	9.625
	Pietermaritzburg (SABC-II		4.878		(Delhi Relay)	VUC2	6.010	0320V	Rome (To Pacific, Far East)	GRG	11.810
	BBC Relay)				Madras (Delhi Relay)	VUM3	7.280	0530	London (ES—Minimum Speed)	GWT	9.675
	Los Angeles (AFRS)	KNBX	15.250			VUM2	6.085			GSW	7.230
		KWID	11.900		Los Angeles (AFRS-To Pacific)	KWID	11.900			GSY	6.040
		KCBF	9.570			KCBF	11.810	(NF)	Damascus		11.750
		KWIX	9.570			KGEK	11.730				6.000
		KCBA	6.120			KWIX	9.570				5.005 A
	Tokyo (AFRS)	JKL2	9.805			KCBA	6.120		Perth (ABC)	VLX2	4.997
		JKK	6.015		Lake Success (UN Via VOA)	KNBA	9.700		Singapore (Radio Network)		7.210
0110	Edmonton	VEA1	9.540	(NS)		KNBI	6.080		St. Johns	CBNX	5.970
	Melbourne (ABC)	VLR	9.540		(Via Honolulu)	KRHO	17.800	(NS)	Accra	ZOY	9.640
	Brisbane (ABC)	VLQ3	9.680		(Via Manila)	II	15.330	0545	London (ES)	GRG	11.880
	Perth (ABC)	VLM	4.917.5		Tokyo (AFRS)	JKL2	9.805			GWTD	9.675
	Dacca (Karachi Relay)		7.635		Melbourne (ABC)	VLR	9.540		Port-of-Spain	VP4RD	9.625
					(ABC)			0550V (F-Th-Rat)	Copenhagen	OZH	15.185
0115	Belgrade				(ABC)	VLQ3	9.680				
	London (ES)	CWJ	9.525	0315 (NS)		VLM	4.917.5				
		GSU	7.260								
		OWL	7.210								

NOTES: GMT is equal to EST plus hours. Winter schedules are given, in many cases during summer, schedules will be one hour earlier than listed herein. In a few instances, stations temporarily off the air, but scheduled to return this spring - have been included. Frequencies are listed in megacycles; to convert to meters, divide 300 by the frequency in megacycles. In some cases, frequencies are "measured" in others are "announced" or "listed" channels.

reg. in other areas. ¹ Lastest ² ³ ⁴ ⁵ ⁶ ⁷ ⁸ ⁹ ¹⁰ ¹¹ ¹² ¹³ ¹⁴ ¹⁵ ¹⁶ ¹⁷ ¹⁸ ¹⁹ ²⁰ ²¹ ²² ²³ ²⁴ ²⁵ ²⁶ ²⁷ ²⁸ ²⁹ ³⁰ ³¹ ³² ³³ ³⁴ ³⁵ ³⁶ ³⁷ ³⁸ ³⁹ ⁴⁰ ⁴¹ ⁴² ⁴³ ⁴⁴ ⁴⁵ ⁴⁶ ⁴⁷ ⁴⁸ ⁴⁹ ⁵⁰ ⁵¹ ⁵² ⁵³ ⁵⁴ ⁵⁵ ⁵⁶ ⁵⁷ ⁵⁸ ⁵⁹ ⁶⁰ ⁶¹ ⁶² ⁶³ ⁶⁴ ⁶⁵ ⁶⁶ ⁶⁷ ⁶⁸ ⁶⁹ ⁷⁰ ⁷¹ ⁷² ⁷³ ⁷⁴ ⁷⁵ ⁷⁶ ⁷⁷ ⁷⁸ ⁷⁹ ⁸⁰ ⁸¹ ⁸² ⁸³ ⁸⁴ ⁸⁵ ⁸⁶ ⁸⁷ ⁸⁸ ⁸⁹ ⁹⁰ ⁹¹ ⁹² ⁹³ ⁹⁴ ⁹⁵ ⁹⁶ ⁹⁷ ⁹⁸ ⁹⁹ ¹⁰⁰ ¹⁰¹ ¹⁰² ¹⁰³ ¹⁰⁴ ¹⁰⁵ ¹⁰⁶ ¹⁰⁷ ¹⁰⁸ ¹⁰⁹ ¹¹⁰ ¹¹¹ ¹¹² ¹¹³ ¹¹⁴ ¹¹⁵ ¹¹⁶ ¹¹⁷ ¹¹⁸ ¹¹⁹ ¹²⁰ ¹²¹ ¹²² ¹²³ ¹²⁴ ¹²⁵ ¹²⁶ ¹²⁷ ¹²⁸ ¹²⁹ ¹³⁰ ¹³¹ ¹³² ¹³³ ¹³⁴ ¹³⁵ ¹³⁶ ¹³⁷ ¹³⁸ ¹³⁹ ¹⁴⁰ ¹⁴¹ ¹⁴² ¹⁴³ ¹⁴⁴ ¹⁴⁵ ¹⁴⁶ ¹⁴⁷ ¹⁴⁸ ¹⁴⁹ ¹⁵⁰ ¹⁵¹ ¹⁵² ¹⁵³ ¹⁵⁴ ¹⁵⁵ ¹⁵⁶ ¹⁵⁷ ¹⁵⁸ ¹⁵⁹ ¹⁶⁰ ¹⁶¹ ¹⁶² ¹⁶³ ¹⁶⁴ ¹⁶⁵ ¹⁶⁶ ¹⁶⁷ ¹⁶⁸ ¹⁶⁹ ¹⁷⁰ ¹⁷¹ ¹⁷² ¹⁷³ ¹⁷⁴ ¹⁷⁵ ¹⁷⁶ ¹⁷⁷ ¹⁷⁸ ¹⁷⁹ ¹⁸⁰ ¹⁸¹ ¹⁸² ¹⁸³ ¹⁸⁴ ¹⁸⁵ ¹⁸⁶ ¹⁸⁷ ¹⁸⁸ ¹⁸⁹ ¹⁹⁰ ¹⁹¹ ¹⁹² ¹⁹³ ¹⁹⁴ ¹⁹⁵ ¹⁹⁶ ¹⁹⁷ ¹⁹⁸ ¹⁹⁹ ²⁰⁰ ²⁰¹ ²⁰² ²⁰³ ²⁰⁴ ²⁰⁵ ²⁰⁶ ²⁰⁷ ²⁰⁸ ²⁰⁹ ²¹⁰ ²¹¹ ²¹² ²¹³ ²¹⁴ ²¹⁵ ²¹⁶ ²¹⁷ ²¹⁸ ²¹⁹ ²²⁰ ²²¹ ²²² ²²³ ²²⁴ ²²⁵ ²²⁶ ²²⁷ ²²⁸ ²²⁹ ²³⁰ ²³¹ ²³² ²³³ ²³⁴ ²³⁵ ²³⁶ ²³⁷ ²³⁸ ²³⁹ ²⁴⁰ ²⁴¹ ²⁴² ²⁴³ ²⁴⁴ ²⁴⁵ ²⁴⁶ ²⁴⁷ ²⁴⁸ ²⁴⁹ ²⁵⁰ ²⁵¹ ²⁵² ²⁵³ ²⁵⁴ ²⁵⁵ ²⁵⁶ ²⁵⁷ ²⁵⁸ ²⁵⁹ ²⁶⁰ ²⁶¹ ²⁶² ²⁶³ ²⁶⁴ ²⁶⁵ ²⁶⁶ ²⁶⁷ ²⁶⁸ ²⁶⁹ ²⁷⁰ ²⁷¹ ²⁷² ²⁷³ ²⁷⁴ ²⁷⁵ ²⁷⁶ ²⁷⁷ ²⁷⁸ ²⁷⁹ ²⁸⁰ ²⁸¹ ²⁸² ²⁸³ ²⁸⁴ ²⁸⁵ ²⁸⁶ ²⁸⁷ ²⁸⁸ ²⁸⁹ ²⁹⁰ ²⁹¹ ²⁹² ²⁹³ ²⁹⁴ ²⁹⁵ ²⁹⁶ ²⁹⁷ ²⁹⁸ ²⁹⁹ ³⁰⁰ ³⁰¹ ³⁰² ³⁰³ ³⁰⁴ ³⁰⁵ ³⁰⁶ ³⁰⁷ ³⁰⁸ ³⁰⁹ ³¹⁰ ³¹¹ ³¹² ³¹³ ³¹⁴ ³¹⁵ ³¹⁶ ³¹⁷ ³¹⁸ ³¹⁹ ³²⁰ ³²¹ ³²² ³²³ ³²⁴ ³²⁵ ³²⁶ ³²⁷ ³²⁸ ³²⁹ ³³⁰ ³³¹ ³³² ³³³ ³³⁴ ³³⁵ ³³⁶ ³³⁷ ³³⁸ ³³⁹ ³⁴⁰ ³⁴¹ ³⁴² ³⁴³ ³⁴⁴ ³⁴⁵ ³⁴⁶ ³⁴⁷ ³⁴⁸ ³⁴⁹ ³⁵⁰ ³⁵¹ ³⁵² ³⁵³ ³⁵⁴ ³⁵⁵ ³⁵⁶ ³⁵⁷ ³⁵⁸ ³⁵⁹ ³⁶⁰ ³⁶¹ ³⁶² ³⁶³ ³⁶⁴ ³⁶⁵ ³⁶⁶ ³⁶⁷ ³⁶⁸ ³⁶⁹ ³⁷⁰ ³⁷¹ ³⁷² ³⁷³ ³⁷⁴ ³⁷⁵ ³⁷⁶ ³⁷⁷ ³⁷⁸ ³⁷⁹ ³⁸⁰ ³⁸¹ ³⁸² ³⁸³ ³⁸⁴ ³⁸⁵ ³⁸⁶ ³⁸⁷ ³⁸⁸ ³⁸⁹ ³⁹⁰ ³⁹¹ ³⁹² ³⁹³ ³⁹⁴ ³⁹⁵ ³⁹⁶ ³⁹⁷ ³⁹⁸ ³⁹⁹ ⁴⁰⁰ ⁴⁰¹ ⁴⁰² ⁴⁰³ ⁴⁰⁴ ⁴⁰⁵ ⁴⁰⁶ ⁴⁰⁷ ⁴⁰⁸ ⁴⁰⁹ ⁴¹⁰ ⁴¹¹ ⁴¹² ⁴¹³ ⁴¹⁴ ⁴¹⁵ ⁴¹⁶ ⁴¹⁷ ⁴¹⁸ ⁴¹⁹ ⁴²⁰ ⁴²¹ ⁴²² ⁴²³ ⁴²⁴ ⁴²⁵ ⁴²⁶ ⁴²⁷ ⁴²⁸ ⁴²⁹ ⁴³⁰ ⁴³¹ ⁴³² ⁴³³ ⁴³⁴ ⁴³⁵ ⁴³⁶ ⁴³⁷ ⁴³⁸ ⁴³⁹ ⁴⁴⁰ ⁴⁴¹ ⁴⁴² ⁴⁴³ ⁴⁴⁴ ⁴⁴⁵ ⁴⁴⁶ ⁴⁴⁷ ⁴⁴⁸ ⁴⁴⁹ ⁴⁵⁰ ⁴⁵¹ ⁴⁵² ⁴⁵³ ⁴⁵⁴ ⁴⁵⁵ ⁴⁵⁶ ⁴⁵⁷ ⁴⁵⁸ ⁴⁵⁹ ⁴⁶⁰ ⁴⁶¹ ⁴⁶² ⁴⁶³ ⁴⁶⁴ ⁴⁶⁵ ⁴⁶⁶

ABC—Australian Broadcasting Commission, AFPS—Armed Forces Radio Service, AIR—All India Radio, BBC—British Broadcasting Corporation, BDN—Blue Danube Network, BFBS—British Forces Broadcasting Service, BFOS—British Forces of Occupation Station, CBC—Canadian Broadcasting Corporation, ES—European Service, FBS—Forces Broadcasting Service (Middle East), GOS—General Overseas Service, NA—North America, RA—Radio Australia, RDF—Radio Diffusion Française, RNE—Radio Nacional de España, SABC—South African Broadcasting Corporation, SRI—Servicio Radiofónico Internacional (International Service), UN—United Nations, VOA—Voice of America, WWBC—World Wide Broadcasting Corporation.



International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

DIRECT from Djakarta (formerly Batavia), Ir. M. P. Breedveld, Chief Engineer of *Djakarta Radio*, sends me this data:

The broadcasting organizations in Indonesia have been consolidated into a government broadcasting service called *Radio Republik Indonesia Serikat* ("Serikat" means "United"); address is Sambir Selaton 17, Djakarta, Indonesia.

The new 100 kw. transmitter is now in regular service as YDF on 6.045 with Indonesian programs 1700-1900, 2300-0130, 0400-1900 weekdays, and 1800-0130, 0400-1000 Sundays; a new *English* period follows at 1000-1100 for South East Asia and the West Coast of North America. The 100 kw. transmitter is used as YDF3 on 11.795 for programs in Arabic 1115-1200, French 1200-1300, and Dutch 1300-1400, beamed to India, the Near East, and Europe; the *English* period for Europe has not been put into effect yet, but in the spring when propagation conditions improve, it may be added for around 1400-1500. The *English* program for Australia and Malaya is on YDC, 15.150, and YDB2, 4.910, the former with antenna radiating the power of YDC in a narrow beam to Australia only. The French program 1000-1100 for South East Asia and Africa is radiated on YDC, 15.150, to South Africa; YDE, 11.770, to Indo-China; YDB3, 7.270, to India, and YDD2, 4.865, omnidirectional.

These transmitters at Djakarta were listed as active:

YDB, 2.240, 300 watts; YDB2, 4.910, 1 kw.; YDB3, 7.270, 3 kw.; YDC, 15.150, 3 kw.; YDD, 2.600, 300 watts; YDD2, 4.865, 3 kw.; YDE, 11.770, 3 kw.; YDF, 6.045, and YDF3, 11.795, 100 kw.

Radio Club Notes

England—Roy Patrick is now vice-president of the *Sveeden DX Fan Club* and is starting a monthly bulletin for that organization. It will contain broadcast, s.w. and amateur band news, as well as club news. The club is arranging several special DX broadcasts for 1950. Membership fees in this club are now 4 IRC's a year. Headquarters is 5, Aldred Street, Workop, England.

New Zealand—The *New Zealand Radio DX League* recently chose these officers for the year: President, Jack F. Fox; vice-presidents, Arthur T. Cushen and Jim I. Martin; secretary-

treasurer, Des L. Lynn; board members, Lynn M. Gerrie, Peter Thorn, Lloyd E. Warburton, Bill March, Alex J. Allan, and A. Mervyn Branks, in addition to the officers. Officials of the club's monthly house organ, *The New Zealand DX Times*, include A. Mervyn Branks, editor; Arthur T. Cushen, short-wave editor and publicity agent; Ron Gray, amateur editor; Alex Allan, circulation manager and assistant editor; Lloyd Warburton, competitions editor; George Goodsir, printer; Bill Marsh, secretary, and Dudley Carter, treasurer.

Sweden—The *Radio Club of Sweden* (SRK) has started a novel service for its *English*-speaking members; each month a digest of the more important items of its house organ—*DX-Radio*—are translated into *English* and are airmailed to *English*-speaking members, while the house organ then follows by regular mail.

This Month's Schedules

Algeria—Mesquita e Sousa, Portugal, reports *Radio Alger* on 9.570 at 1400-1500 with Arabic music.

Angola—Widely reported in CR6RG, approximately 9.240, "*Radio Club de Huambo*," Nova Lisboa, afternoons to 1500 or later. Peddle, Newfoundland, says he hears an outlet on 11.945 in parallel around 1415-1500 or later; announced as operating in the 32- and 25-m. bands. Laubscher, South Africa, airmails that this is a powerful outlet on approximately 9.240, compared to other Angolan outlets, probably at least 1 kw. in power.

Galen Balfe, Massachusetts DX'er, collects both ISW and ham QSL cards. He is using a Hallicrafters S-40A, a RME DB-22A preselector, and a Silver sideband selector. More recently he has rigged up a 100 kc. frequency standard to round out his post.



Australia—VLA6, 15.220, is now in use to Eastern North America 1643-1815; fine level.

Austria—The Blue Danube Network, Salzburg, reported off the air sometime ago, is now being heard on 9.532, operating under heavy QRM. (Radio Sweden)

Burma—A Forces Station reported heard in Israel, Australia, New Zealand, and India on approximately 7.375 around 0800-0830, in *English*, is reported to be *Radio Mandalay*; another report lists it as "*Karen Radio*." (Radio Australia)

Canada—A letter verification from CKFX, Vancouver, British Columbia, stated that this is the s.w. counterpart of medium-wave CKWX and is used "to serve the mountainous areas of British Columbia which cannot be reached by CKWX." Operates on 6.080 with 10 watts, using a quarter-wave vertical antenna; output tube is a single 807 at 400 volts; closes down 0305; is privately-owned. (Cox, Del., Lytle, Ontario)

CJCX, 6.010, Sydney, Nova Scotia, 1 kw., relaying CJCB, 1270 kc., 5 kw., is scheduled weekdays 0600-2315, Sundays 0800-2315.

Cape Verde Islands—CR4AA, 5.920, heard in Chicago 1640 with good signal; news in Portuguese. (Whitman)

Costa Rica—TIFC, San Jose, informed Lytle, Ontario, it is operating with 350 watts from a home-built transmitter; frequency is 9.645; is owned by the Latin American Mission, Inc., Ridgefield Park, New Jersey; usually has *English* 2230-0005; good signal in Ontario.

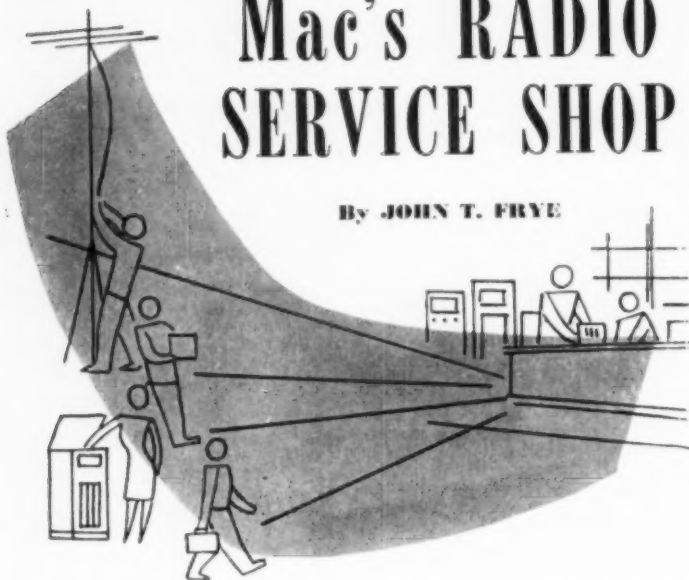
Cuba—COBZ, 9.026, Havana, noted with *English Lesson* (recorded by BBC) at 1800-1815. (Selman, Texas, others)

Ethiopia—Bluman, Israel, lists schedule of *Radio Addis Ababa*, "*Voice of Ethiopia*," as ETA, 9.620, 0600-0645, 0845-1100, with *English* 1010-1100; and ETB, 15.032, which is being used experimentally. He states further that on Tuesdays an additional schedule of 1230-1400 is in effect, with programs (Continued on page 139)

(Note: Unless otherwise indicated, all time is expressed in American EST, add 5 hours for GMT. "News" refers to newscasts in the *English* language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400. The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given.)

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE



A SUDDEN extra-strong gust of wind jerked the opening door from Barney's fingers and slammed it back against the wall. Before he could step inside the service shop and close the door, the same mischievous whirlwind scooped a bunch of papers from the desk at which Mac and the office girl, Miss Perkins, were sitting and sent the sheets sailing wildly about the office.

"That's our boy, Barney," Mac observed resignedly as he recovered the scattered papers. "He and March both come in like lions."

"Man! The wind out there is twenty db. over S9," Barney said as he perched himself on a corner of the desk. "What are you two in a huddle about?"

"We were just talking about letting you go and getting an intelligent monkey to take your place," Mac explained blandly. "I was pointing out that with all the climbing that has to be done putting up these TV antennas, a good, reliable, sure-grip tail would be worth more to a service technician than any amount of brains; and as far as there being any great difference in brains, if the monkey is only reasonably intelligent."

"He's just teasing you, Barney," Miss Perkins broke in quickly as she saw a look of genuine concern cross the boy's freckled face. "We were just working out a parts order in preparation for the April portable-special Mac is planning."

"The whatable special?"

"Portable-special," Mac replied. "During the last two weeks of April we are going to run an offer to check the batteries, tubes, and general operating condition of any portable re-

ceiver brought to the shop for only one buck. Newspaper ads and radio spot announcements will urge the good people to dig their portable sets out of the closets and bring them to us so that we can put them in top-notch shape for the picnic-beach-party-and-baseball-game season."

"A single George Washington doesn't seem like much money for the kind of check you will give them—or rather make me give them," Barney said dubiously.

"True, but a high percentage of those sets are bound to need new tubes or batteries or both. Quite a few of them will take some further work to put them into shape. As our advertising will make crystal-clear, that 'George Washington' as you call it simply pays for testing the tubes and batteries and calling attention to any defects that need remedying. Any further service will be charged for at our usual rates."

Before Barney could pursue the subject, the door opened to admit a pretty young woman who was all the prettier with her hair slightly tousled by the wind.

"Hello, Gay," Mac greeted her. "What can we do for you?"

"My big radio has gone dead, Mr. McGregor, and I was wondering when you could fix it."

"Hm-m-m-m," Mac said as he took a quick look at the call-list beside the telephone. "It will probably be two or three days. We are really snowed under this week."

She made a little face of disappointment, but she said, "Well, it will just have to wait until then, for my husband told me never to let anyone touch it but you. Just stop by and

pick it up when you get the chance."

"Wait a minute, Gay," Mac said as she started for the door. "I can't run your set around others in the shop during regular working hours; but I guess I can work on it on my own time if I please. I know what that set means to you, and I also know that my wife is having a bridge party at our house tonight. I'll pick up your set right after supper and bring it down here and see what is the matter with it. I'd much rather be here working than sitting at home in the basement re-reading old magazines and wondering if those gals are never going home."

"You are trying awfully hard to make it sound as though I were doing you a favor, but I think you know how much I appreciate this," Gay said with a dazzling smile that seemed to hang in the air long after she had closed the door behind her—or at least it seemed so to Barney, who was more than somewhat susceptible to feminine charm.

"Not that I blame you, Boss," Barney said softly, "but weren't you the one who gave me a lecture last week about not letting a pretty face wheedle special favors out of me? And she's a married woman, too!"

"The pretty face has nothing to do with it," Mac answered gruffly. "I happen to know the circumstances. That set is an all-wave job that she uses to listen for her G.I. husband in Germany who gets a chance to talk over a ham station from there every now and then. Since she actually talked to him over Herb Thorne's ten-meter rig, she spends half her time listening to the ham bands on the off chance she will hear her husband's voice."

"And while we are talking, Fireball, I may as well take up another little matter. I realize I told you the only fair way was to repair sets exactly in the order in which they came in and that you were not to run one radio around another just to keep from losing a service job; but do you have to sound so coldly impersonal when you tell a poor guy that you can't get on his receiver immediately, even though it is the only one he has in the house?"

"Try to keep in mind that it is not just a radio he has brought you. That dead set he holds in his hands represents a worrisome trouble that he hopes you can help him get rid of. If you can't do that immediately, the least you can do is be properly sympathetic and show that you actually would like to help him."

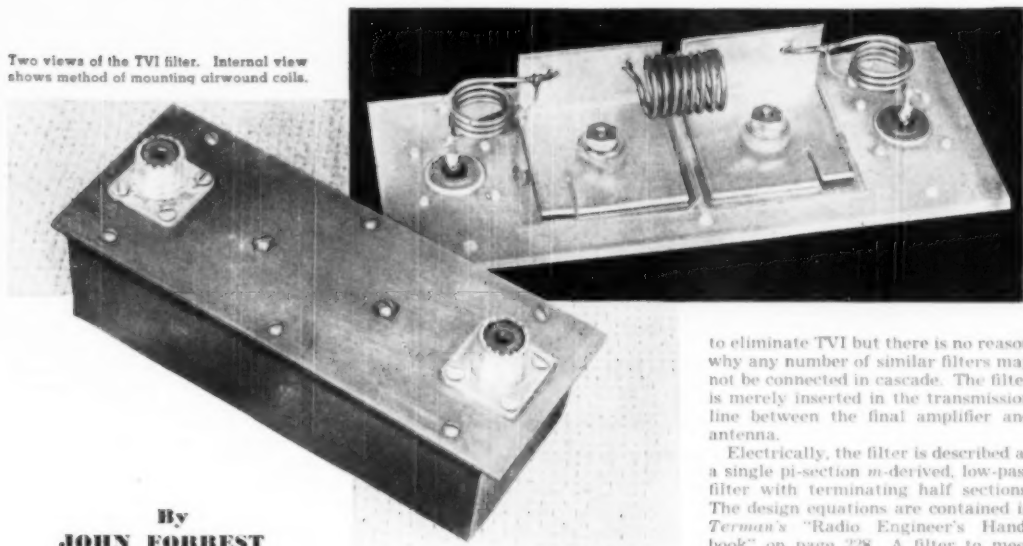
"I get it; you want me to put on the old I-wish-I-could-but-I-can't act."

"No you don't get it," Mac said with a thoughtful frown. "I don't want you just to pretend you are sorry; I want you to be sorry. It's part of being a real service technician. This wacky business we are in is called 'radio service'; and we never want to concentrate so hard on the 'radio' end of it that we forget the 'service' part. People depend upon us to do a par-

(Continued on page 84)

A TVI Filter for Coaxial TRANSMISSION LINES

Two views of the TVI filter. Internal view shows method of mounting airwound coils.



By
JOHN FORREST

Complete details for an antenna feedline filter which reduces radiation of harmonics falling in the TV band.

THE increasing number of television receivers is a source of concern to all amateurs. In urban areas the amateur is likely to be completely surrounded by television receivers, each a potential threat to the ham version of "pursuit of happiness." In small communities, remote from television stations, TVI is also a serious problem since the use of high gain boosters and antennas compounds the difficulty. The amateur who wishes to be free of TVI must begin immediately to rid his equipment of spurious radiations. The task of "delousing" the average amateur transmitter is formidable but successful techniques are being developed which may be applied to all transmitters, e.g., shielding, power line filters, class B operation of r.f. stages, use of FM, and finally, antenna feedline filters.

The antenna feedline filter should be considered standard equipment by the amateur who has many television receivers nearby. Excellent filters are available from several manufacturers. These filters are usually designed for coax for several reasons: It is easier to construct a filter for coax than for

balanced lines; the excellent shielding of coax reduces the probability of TVI to begin with; and surplus coax such as RG-8 U is cheap and plentiful and has lower loss than any of the other commonly used amateur feedlines. The difficulty of feeding a balanced load with coax is ordinarily sufficient to deter many from using it, but there are several excellent methods of accomplishing the job. For instance, a substantial advance in this respect appears to have been made by W3MTE with the "Gamma match."¹

The filter shown in the photographs is intended primarily for use in RG-8/U cable feeding a 10 meter beam antenna. It is suitable for use in any 50 ohm coaxial cable on any band between 160 and 10 meters. Transmission characteristics of the filter are plotted from 2 mc. to 200 mc. The measurements were made with a Measurements Corp. Model 80 laboratory signal generator and an r.f. voltmeter across a 50 ohm termination. The minimum attenuation in the stop band is 30 db., near 60 mc. This should be adequate

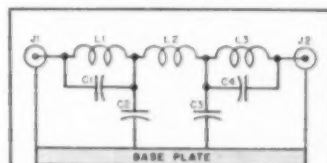
to eliminate TVI but there is no reason why any number of similar filters may not be connected in cascade. The filter is merely inserted in the transmission line between the final amplifier and antenna.

Electrically, the filter is described as a single pi-section *m*-derived, low-pass filter with terminating half sections. The design equations are contained in Terman's "Radio Engineer's Handbook" on page 228. A filter to meet a particular requirement may be designed from these equations. The construction technique used in this model is recommended for similar devices operating in the television frequency ranges.

All components are assembled on a $\frac{1}{8}$ " brass plate. This thick material is used for rigidity so that the bypass capacitors will be constant once adjusted. Each condenser top plate is secured by a single screw with a shoulder washer for insulation. The top plates are $\frac{1}{16}$ " material. Each top plate has a right angle bend in it with holes through which the ends of the coils are passed for soldering. This style of condenser has high break-down voltage, high current-carrying capacity, and most im-

(Continued on page 128)

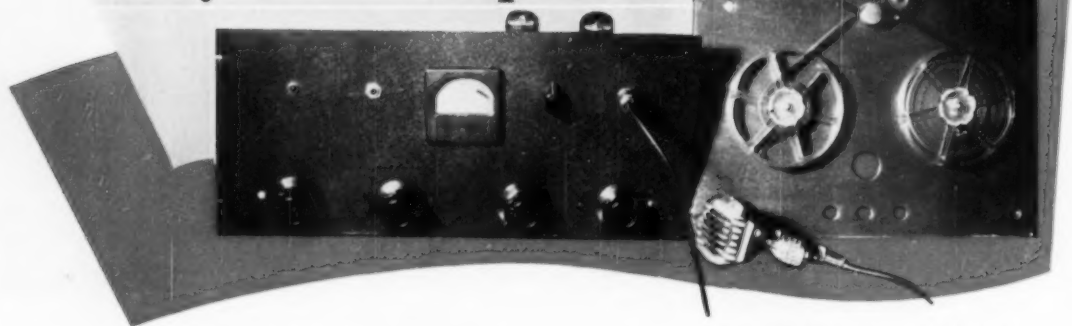
Diagram and parts list for TVI filter.



C_1, C_3 —94 mfd. mica cond. (a 100 mfd. $\pm 10\%$ is satisfactory)
 C_2 —141 mfd. plate cond. (see text)
 L_1, L_2 — $1\frac{1}{2}$ t. ± 14 , $\frac{1}{2}$ " i.d., $\frac{1}{8}$ " long, airwound
 L_3 —8 t. ± 14 , $\frac{1}{2}$ " i.d., $\frac{1}{8}$ " long, airwound

¹ Washburn, H. H.: "The 'Gamma' Match," QST, Sept., 1949.

A Versatile Recording and Playback Amplifier



By GLEN SOUTHWORTH

Construction details for building an amplifier which can be used for either tape, wire, or disc.

AN IMPORTANT branch of the audio art is that which deals with transforming sounds into a form in which they may be kept more or less permanently and reproduced at will. Prior to the recent war, disc and film were the two principal recording techniques. Since then magnetic recording on wire, and particularly tape, has experienced a phenomenal growth.

Each system has its own advantages and disadvantages. Disc records are subject to noise, surface wear, warpage, and may often require expensive, high quality recording equipment for good results. On the credit side they may be kept indefinitely, if well treated, and are convenient in that it is easy to find a particular passage on the record quickly. The merits of sound on film recording may be noted at your neighborhood theater, but, in general, this technique is too expensive and complicated for widespread general use.

Magnetic recording has several advantages over other types of systems, one of the chief ones being that no mechanical linkage is used in either recording or playback. This results in considerably lowered distortion, particularly of transients, and the ability to be replayed indefinitely without deterioration of quality. Although good results may be obtained on either wire or tape, tape recording seems preferable from the standpoint of better mechanical properties, ease of editing, and generally greater advancement in the art.

The amplifier described in this article was designed for use in recording or playback of disc, wire, or tape, and may be used for re-recording from any of these media to another. Push-pull 6L6's are used in the output stage to give ample power to drive either a loudspeaker or magnetic disc recording head, while a high frequency oscillator is included to provide bias and erase voltage for either wire or tape.

The high gain required for the playback of tape recordings gives rise to several problems. One of these is reducing the hum level to a low value. Other than inadequate filtering, ground loops are a common source of disturbance and it is recommended that an isolated ground system, connected to the chassis at only one point, be used. Another problem arises when the high frequency energy from the bias oscillator gets into the amplifier stages and creates distortion and lack of sensitivity. A wide range oscilloscope is very useful in tracking down this difficulty and eliminating the trouble through use of proper shielding or bypassing.

Another serious problem occurs when energy from the output of the amplifier gets back into the input, causing oscillation or instability. The simplest way to reduce this effect is to separate the input and output circuits physically, and manually change the position of the recording-playback head connection from output to input. If it seems desirable to have a more convenient switching arrange-

Panel view of the recording and playback amplifier. Author used his unit in conjunction with the tape recorder shown.

ment, a multiple section switch, such as shown in the accompanying diagram, may be used. In this case, sections of the switch are used as conductors in one position and shields in the other, making good electrical separation possible.

For single track recording the author has found that a small permanent magnet makes a good, yet simple erase mechanism and has the advantage that an entire reel of tape may be cleared in the short period of time during rewind or fast speed forward, while electronic means do not usually work satisfactorily at such high speeds. When using permanent magnet erase, a quieter recording appears to result by placing the magnet on the side of the tape away from the magnetic coating. Using one of the small Alnico magnets, the field is usually intense enough to penetrate the tape and provide complete erasure, while the more uniform field produced tends to lower the amount of noise recorded on the tape during the erase process.

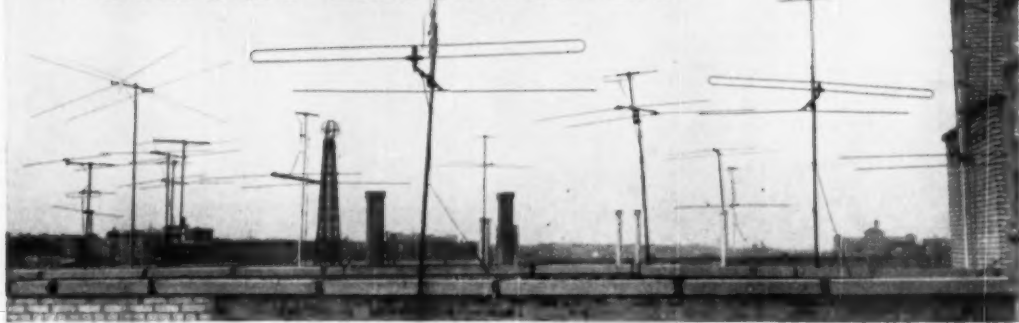
When recording two independent sound tracks on standard tape, electronic erase becomes desirable due to the fact that the erase area may be carefully controlled so as not to overlap and attenuate the adjacent recording. For this reason the bias oscillator in the recording amplifier is designed to supply several watts of high frequency power, sufficient to operate an erase head for either tape or wire.

A considerable variety of recording-playback heads is now on the market. Probably the easiest of these to use is the high impedance head which may be driven by a simple triode voltage amplifier stage. As

Assuming a perfectly functioning amplifier, the quality of the recording will depend on a number of factors. Type of recording head, tape, bias frequency, bias amplitude, tape speed, and quality of the original signal should be considered. If using a well matched recording head of good design, the quality of the recording may vary according to the type of tape used with a particular system. This is due to the varying characteristics of different magnetic coatings and the fact that recording level and bias conditions may differ considerably for optimum results. The author's preference is for the brown oxide-coated tape which gives wider range, greater sensitivity, lower distortion and noise, and higher output levels than that obtainable with the less expensive tapes. However, with any tape, if the bias is not correct serious distortion may result, giving either harsh reproduction due to strong third harmonic production or mushiness due to the suppression of low level components, the latter effect apparently being increasingly noticeable at slow tape speeds even though the same frequency range is reproduced.



TELEVISION TROUBLESHOOTING Without Instruments



By **WALTER H. BUCHSBAUM**

Chief Eng., Tech-Master Products Co.

Not all defects can be located—but the procedure outlined describes a method whereby a great number of circuit faults can be found without instruments.

THE title of this article appears to offer a long-awaited panacea to the service industry and the evolution of a nemesis to the test instrument manufacturers. Actually, we do not recommend that you throw out all your instruments, or delay purchasing new ones—not even after you have read this article. The method outlined herein is merely a convenient procedure for locating certain defects when instruments are not available. While most service technicians carry a voltohmmeter on all service calls, few can take a signal generator and an oscilloscope along; and in those instances where the defect would normally be found by signal tracing or signal injection, this method is often of great help. It should be understood clearly that we are not trying to suggest a complete system for troubleshooting all defects, but merely showing how in some cases, some defects can be found without the use of any instruments.

The principle of this new method of troubleshooting is the utilization of one functioning section of the receiver to locate the defect in another section. A study of any TV circuit diagram reveals that the audio amplifier section resembles the circuit of most AM signal tracers. The video section and the sweep circuits, on the other hand, have some similarity to

an oscilloscope. Before showing how these sections of the receiver can be used to locate trouble, it is important that the function of each stage and each section is clearly understood. Lacking this basic knowledge, troubleshooting with or without instruments is only a hit and miss proposition.

Function of Each Stage

Referring to Fig. 1, and starting at the upper left hand corner we find the r.f. amplifier, mixer, and oscillator. These three stages are usually located on a small subchassis and comprise the r.f. tuner or "front end." Because these tubes operate on the television r.f. frequencies and at a relatively low signal level, signal tracing is not practical. If either sound or picture are being received it is safe to assume that the r.f. tuner is operating properly. Even if only static noise is either seen or heard the defect may not be in the tuner. Realignment of the local oscillator slightly may be sufficient to bring in either sound or picture, or both. In any event, troubleshooting the r.f. front end is usually a tedious and difficult job, and most service technicians are content with trying out new tubes and measuring the operating voltages until the set can be brought into the shop for a thorough check-up.

The picture i.f. amplifier consists of a chain of three or four tubes, either types 6AG5 or 6AU6 are the most popular in present day sets, and in most cases a system of stagger tuning is used. This means that each stage is tuned to a different frequency and the relatively high gain of each stage at that frequency adds up to the overall, broadband response curve. One of the drawbacks of this system is that in the event two subsequent tuned circuits are close to each others' resonant frequency, a tendency toward regeneration and oscillation exists. The transformer-coupled system where each stage is broadly tuned over the entire bandwidth is more stable, but more costly and more difficult to align. In either system a broad band of frequencies is being amplified and it is possible to signal trace this section of the receiver. How this is accomplished is described in detail in a later paragraph.

After the i.f. signal is amplified sufficiently it reaches the second detector where the picture signal is removed from the i.f. carrier and amplified further. This signal has three main components: the actual picture part which determines the light and dark on the screen, the horizontal sync pulses, and the vertical sync pulses. The horizontal sync pulses and most of the picture consist of frequencies too high to be audible, or to be reproduced by conventional loudspeakers. The 60-cycle pulse which forms the vertical sync signal, however, is audible as a low rasping noise. Where a pair of earphones is connected to the output of the last video amplifier this rasping noise can be heard clearly, but for our new method of troubleshooting the audio amplifier of the set will be utilized to trace the path of the picture signal.

RADIO & TELEVISION NEWS

The sound signal is separated from the picture signal in two different ways. In the block diagram of Fig. 1, the Intercarrier System is shown, because this system is becoming more and more popular, especially among lower priced sets. The sound and picture i.f. signals are amplified together through the chain of i.f. stages and at the second detector the sound i.f. carrier beats with the picture i.f. carrier. Since their difference frequency is 4.5 mc., a second sound i.f. of that frequency is created which is then amplified, along with the picture signal, through the video amplifiers. This 4.5 mc. signal is trapped out at the plate of the last video stage and fed to the sound limiter-amplifier. The 4.5 mc. carrier is frequency modulated and the sound is detected by a ratio detector type circuit.

After passing through a de-emphasizing filter the audio signal is then applied to a conventional two-stage audio amplifier. This two-stage amplifier is very useful as a signal tracer for troubleshooting either video stages or the vertical sweep and synchronizing section.

Many older type sets and most of the more expensive models use a separate sound i.f. channel, usually tuned to 21.25 mc., and a discriminator type of detector circuit. The sound i.f. carrier is removed from the picture i.f. signal either through a tuned trap at the mixer plate or in one of the first two i.f. stages. In this system the picture i.f. amplifiers, following the point of sound i.f. removal, will always have at least one more trap to eliminate the sound signal. A conventional audio amplifier circuit is used after the detector, just as in the Intercarrier System.

In addition to the sound and picture signals, a television system also requires synchronizing pulses for both the vertical 60-cycle sweep and the horizontal scanning which has a frequency of 15,750 c.p.s. Both pulses are present in the final picture signal as it reaches the picture tube, and usually a portion of this picture signal is applied to the synchronizing circuits. Depending on the method of generating the sweep voltages, different amplitude and phase of sync pulses may be required. In all cases, however, both vertical and horizontal pulses are passed through at least one clipper-limiter stage as shown in Fig. 1. If this stage is functioning properly, both pulse frequencies will be present at its output, and while the 15,750 c.p.s. signal is nearly inaudible the 60-cycle pulse is clearly distinguished as a low rasping hum, when the signal is run through the audio amplifier. Sync pulse separation is achieved by using an integrating network to pass only the 60-cycle pulses and a small coupling condenser to pass only the 15,750 c.p.s. horizontal sync pulses.

The vertical sweep section shown in Fig. 1 is one of the simplest in use, requiring only a single 6SN7 tube of

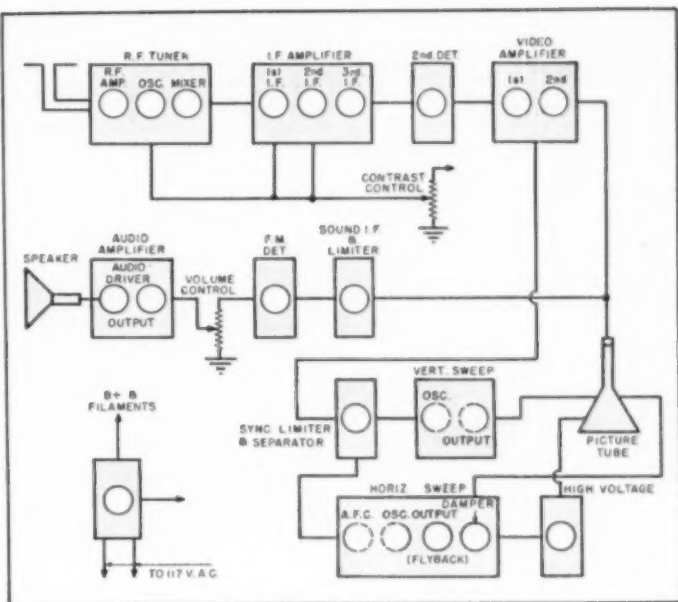


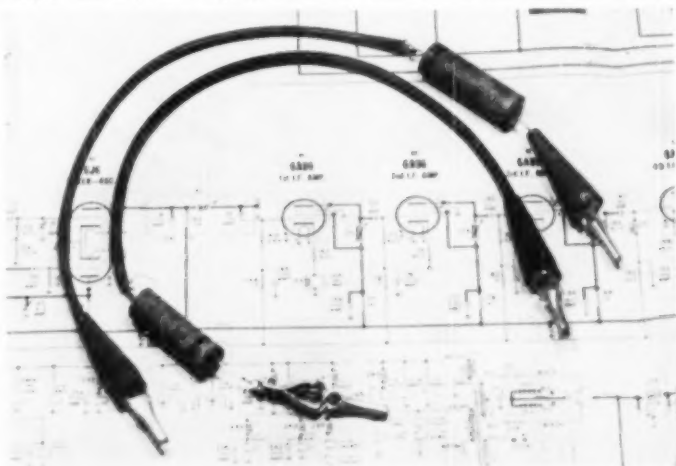
Fig. 1. Block diagram shows functional operation of a conventional television receiver.

which one triode section is used as the oscillator and discharge tube and the other as the output amplifier. Some receivers may use two or even three tubes for this purpose, but the principles are the same and signal tracing can be done in a manner similar to that outlined in a later paragraph.

Fig. 1 shows a frequently used system of a.f.c. (automatic frequency control) used to hold the horizontal sweep steady. The actual functions of each stage in the horizontal sweep circuit and high voltage section will

not be discussed here because this part of the receiver does not lend itself directly to troubleshooting without instruments. Unless an obvious short or broken part is apparent in the horizontal sweep and high voltage section, the fastest method of locating the defect is by signal tracing with an oscilloscope. The only way in which the method described in this article can be applied to this section is by tracing the sync pulses to the output of the sync separator stage and assuming that since the vertical output is observed there, the hori-

Fig. 2. The only "tools" required to make the troubleshooting tests outlined in article.



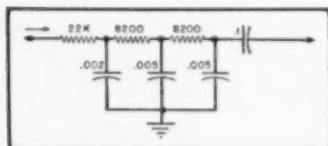


Fig. 3. Vertical sync pulse integrator network used almost universally for removing the horizontal sync pulses permitting only the vertical sync pulses to pass through.

zontal output must also be present and any loss of sync pulse must, therefore, take place in a subsequent stage.

The filament and "B plus" circuits can usually be checked easily by the old radio technician's standby, the spark test. In the event an open filament choke or transformer winding is suspected the audio amplifiers can be used to trace this defect. In general, these circuits can be serviced more efficiently with any conventional volt-ohmmeter.

Practical Applications

If the exact function and the nature of each stage in the modern television receiver is thoroughly understood, the actual application of the method outlined in this article will present no difficulties. A little practice is helpful, especially in those parts where the audio section is used as a signal tracer. Once the technician learns to recognize the different sounds, locating the defective part is usually only a matter of minutes. Among the most frequent applications of the instrument-less method are the following major symptoms which are discussed in detail:

1. No sound, no picture.
2. No sound or weak sound with good picture.

3. No picture or weak picture with good sound.

4. No vertical sweep or very little sweep.

5. Loss of vertical or horizontal sync or both.

Other defects, such as intermittent front end tuners, no high voltage, burned or shorted components, etc., do not lend themselves readily to troubleshooting without instruments and it will be found that they can be serviced more efficiently with conventional equipment.

1. *No sound, no picture.* This condition can be due either to the loss of the signal in the r.f. stages because of a power supply failure or, especially in sets using the Inter-carrier System, because of a defect in the picture i.f. or video amplifiers. To ascertain whether a picture signal is present in the video amplifiers connect a .05 μ fd. condenser, through a clip or test lead, to the "high" side of the volume control. Touch the free end of the condenser to a filament pin anywhere in the set. This will produce a loud 60-cycle hum in the speaker, proving that the audio amplifiers are working properly. Next touch the free or "probe" end of the condenser to the plate of the last picture amplifier. If a picture signal is present, a loud rasping hum is heard. If no signal is found, move the "probe" back to the preceding grid, and so on until it is connected to the second detector load resistor. The absence of a picture signal there indicates that the defect must be in either the i.f. or r.f. stages preceding the detector.

To check the i.f. amplifiers would require the insertion of a signal from a generator or at least a multivibrator generating harmonics in the i.f. frequency range. We find, however, that

the set itself contains such a multivibrator in the form of the vertical sweep generator. To utilize the vertical sweep connect a .1 μ fd. condenser to the plate of the vertical sweep output tube and attach a clip or test lead on the free end. As indicated, the audio system is used again and since we know that the defect is not in the video amplifiers it is usually best to connect the "probe" end of the .05 μ fd. condenser from the volume control to the plate of the last video amplifier for best indication. Next touch the free end of the .1 μ fd. condenser to the detector load resistor. A loud buzzing will be heard, showing that the signal passes from there to the last video amplifier.

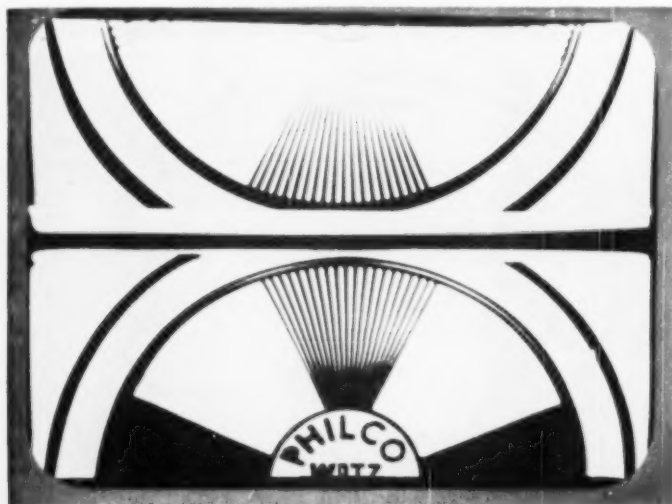
To check the i.f. stages touch the "probe" end of the .1 μ fd. condenser in turn to the plate and grid of each i.f. stage, going from the second detector back to the mixer grid. Receivers using transformer coupled i.f.'s may give only a weak indication which is hard to recognize if some inherent hum is present. To definitely identify the signal from the vertical sweep, rotate the vertical hold control a few times and observe the change in pitch as this is done. This method is, in effect, signal substitution with the vertical sweep circuits providing the signal and the audio amplifiers the detecting device. The vertical sweep voltage used in this method cannot be observed on the picture tube because the pulses occur only in the flyback period during which the tube is usually blanked out. If it is not convenient to use the vertical pulses as a signal, it is often possible to connect a .1 μ fd. condenser from any filament point to the different i.f. grids and then the 60-cycle hum is visible as well as audible. In many sets this works only on the last i.f. stage, because the attenuation at 60-cycles is too great in each stage, but if a .1 μ fd., 600 volt condenser is connected from the cathode of the "B plus" rectifier to the different grid circuits, enough signal is usually passed to cause a dark horizontal bar on the picture tube.

2. *No sound or weak sound but good picture.* Since in this condition a picture is present, the .05 μ fd. condenser is connected to the plate of the last video amplifier and the free end touched first to the grid of the audio tube. A distinct rasping hum should be heard if this stage is functioning. Next we move the free end to the plate of the audio voltage amplifier. The same hum should be heard. If nothing or a weak sound is heard the coupling network between the plate of the voltage amplifier and the grid of the output tube is defective. Moving the free end of the .05 μ fd. condenser back until it is connected to the load resistance of the sound detector will locate any trouble present in the audio amplifiers.

To check the sound i.f. stage in sets using the Inter-carrier System just

(Continued on page 155)

Fig. 4. A double-image pattern of this type indicates loss of vertical synchronization.



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MARS Station of the Month

MARS BEAMS WEEKLY BROADCASTS

MARS—Army Headquarters station, WAR, located at the Pentagon Building, Washington, D. C., broadcasts a weekly message each Tuesday at 0100Z and at 0400Z. (This is Monday at 8 p.m. and 11 p.m., Eastern Standard Time; Monday at 7 p.m. and 10 p.m., Central Standard Time; Monday at 6 p.m. and 9 p.m., Mountain Standard Time; and Monday at 5 p.m. and 8 p.m., Pacific Standard Time.)

Simultaneous broadcasts are made on frequencies 6997.5 kc., 14,405 kc., and 20,994 kc. Each message is sent three times, once at 10 words per minute, once at 15 words per minute, and once at 20 words per minute.

Designed especially to transmit quasi-official traffic and training information to MARS members, the broadcast offers an excellent opportunity to all amateurs in building up their code proficiency.

STATION A6ZQL has been designated the Military Amateur Radio Station-Of-The-Month by Captain E. L. Nielsen, Chief of MARS—Army.

The station is licensed to Major Clifford A. Frink, Signal Corps, who is Chief of Technical Production Section, Armed Forces Radio Service, Armed Forces Information and Education Division, Los Angeles Branch Office, Office of the Secretary of Defense. The station address of A6ZQL is 2109 Dymond Street, Burbank, California.

In the ZQL shack are HT-9 and BC-459 transmitters, an R-9er, an RCA 88 A receiver and a BC-342 receiver with an LS-3 speaker. The Major says, "Just give a call and I'll help you chew your fat... hand key or bug... makes no difference to me 'cause they both make dots and dashes!"

Frink's service extends over a period of 23 years as both an enlisted man and an officer. His entire military service has been directly related with some form of radio, but he did not take out a ham ticket until 1939 when he was

licensed as W5JJE at Fort Bliss, Texas, where he was a non-com with the 1st Cavalry Division.

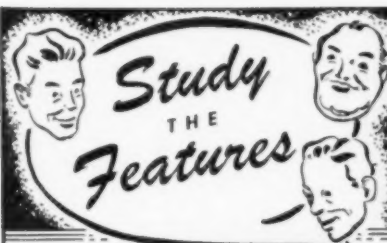
Major Frink was commissioned a Second Lieutenant in the Signal Corps in 1942 and assigned duty with the Western Signal Corps Replacement Training Center at Camp Kohler, California. He was assigned as Officer-in-Charge of the Radio School, and later became Executive Officer of the Signal Communications Branch of this school.

He was assigned duty with the Armed Forces Radio Service in Los Angeles in October of 1943. That same year he went overseas as Engineering Officer for AFRS in the South Pacific and three years later was Chief, AFRS, SOPAC. Still later he served as Chief, AFRS, Middle Pacific and Pacific Ocean Area. He has been assigned in the Los Angeles office, Secretary of Defense, since February, 1947. He went there first as Assistant Chief of the Program Section, then served as Officer-In-Charge, Short-wave Operations Section, before taking over his present duties.

—30—

Twenty-three years of radio have developed a sweet fist and a ham's patience in Major Clifford A. Frink. Here he is shown in QSO at his home station A6ZQL W6ZQL.





Heathkits ARE THE QUALITY LINE OF TEST EQUIPMENT KITS



1 MODERN STYLING

Heathkits have brought a new conception of beauty to laboratories and service benches.

Many organizations have standardized on Heathkits to make their shops appear attractive and uniform.

The panels are produced in grey and morden and the modern streamline aluminum handles give the instruments a pleasant, professional appearance. There is no waste space or false effort to appear large in Heathkits—space on service benches is at a premium and the size of Heathkit instruments is kept as small as is consistent with good engineering design.



COMPLETE KITS

When you receive your Heathkit, you are assured of every necessary part for the proper operation of the instrument.

Beautiful cabinets, handles, two-color panels, all tubes, test leads where they are a necessary part of the instrument, quality rubber line cords and plugs, rubber feet for each instrument, all scales and dials ready printed and calibrated. Every Heathkit is 110V 60 cy. power transformer operated by a husky transformer especially designed for the job.

BEST OF PARTS

You will find many famous names on the parts in your Heathkit. Military switches and filter condensers, Chicago Transformer Corporation and Electrical Assembly Transformers, Centralab Potentiometers, Belden Cable, IRC and Allen Bradley resistors, G.E. tubes, Cinch and Amphonal sockets with silver plated contacts, DeFrance variable condensers, Eby binding post and many other quality parts. The finest of parts are used to assure long trouble-free service from Heathkits.



PRECISION PARTS

Wherever required, the finest quality 1% ceramic resistors are supplied. These require no aging and do not shift. No matching of common resistors is required. You find in Heathkit the same quality voltage divider resistors as in the most expensive equipment.

The transformers are designed especially for the Heathkit unit. The scope transformer has two electrostatic shields to prevent interaction of AC fields.

These transformers are built by several of the finest transformer companies in the United States.



LARGE EASILY READ CALIBRATIONS

No charts or calculations are necessary to use any Heathkit properly. All scales are simply and plainly marked.

The operator instantly knows the proper use of the instrument and can proceed confidently. No multiplication is required as each scale is calibrated independently of the others.



COMPLETE INSTRUCTION MANUALS

Everyone is pleased at the thorough instructions covering the assembly of each Heathkit instrument. Every detail of the assembly is covered, together with sections on the use of the instrument and trouble shooting instructions in case of difficulty. Actual photos of the assembled instrument enable fast and accurate assembly, clear schematics and pictorial diagrams of the confusing parts such as rotary switches, enable the wiring to be completed quickly.

KITS THAT FIT

Heathkit chassis are precision punched to fit the quality parts supplied. The grey crackle aluminum cabinet and the two-color panels are die punched to assure proper fitting.

Many builders have written marveling at the ease with which assembly can be accomplished.

The chassis are specially engineered for easy assembly and wiring—there are no small, tight corners which cannot be reached—the ends of the chassis are left open in order that installation of parts and soldering can be done with both hands.



IDEAL FOR SCHOOLS

Heathkits have been adopted as standard equipment of many of the largest universities and colleges. The low cost plus the fact that the students learn by actual assembly make them ideal training mediums. Many high schools and small colleges are finding that they too can have a modern physics and electronics laboratory by using Heathkits.

Some of the largest technical schools recommend Heathkits to their students as the best means of securing the necessary equipment to start their own shops.



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CABLE: ARLAB-N.Y.

The HEATH COMPANY
... BENTON HARBOR 15, MICHIGAN

Heathkits ARE LABORATORY ENGINEERED ...



Heathkits are engineered in one of the most completely equipped Laboratories for instrument development in the United States.

The NEW V-4 Heathkit VACUUM TUBE VOLTMETER KIT

Features

- Meter scale 17% longer than average 4 1/2" meter.
- Modern streamline 200 ua meter.
- New modern streamline styling.
- Burn-out proof meter circuit.
- 24 Complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory probes (extra) extend ranges to 10,000 Volts and 100 Megacycles.
- Uses 1% precision ceramic divider resistors.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.

The new Heathkit Model V-4 Vacuum Tube Voltmeter has dozens of improvements. A new modern streamlined 200 microampere meter has Aldino V magnet for fast, accurate readings. The new electronic AC voltmeter circuit incorporates an entire new balance control which eliminates contact potential and provides greater accuracy. New simplified switches for quicker assembly. New snap-in battery mounting is on the chassis for easy replacement.

The Heathkit VTVM is the only kit giving all the ranges. Check them — DC and AC full scale linear ranges of 0-5V, 0-10V, 0-50V, 0-100V, 0-500V, 0-1000V and 0-10000V and 0-10,000V DC with accessory probe at slight extra cost. Electronic ohmmeter has six ranges measuring resistance accurately from 1 ohm to one billion ohms. Meter pointer can be offset to zero center for FM alignment.

The DC probe is isolated for dynamic measurements. Has db scale for making gain and other audio measurements.

The new instruction manual features pictorial diagrams and step-by-step instructions for easy assembly. The Heathkit VTVM is complete with every part — 110V transformer operated with test leads, tubes, light aluminum cabinet for portability, giant 4 1/2" 200 microamp meter and complete instruction manual.

Order now and enjoy it this entire season. Shipping weight 8 lbs., Model V-4



\$24⁵⁰

THE FINEST VTVM KIT AVAILABLE
FOR THIS PRICE.

Accessory: 10,000V high voltage probe, No. 310, \$4.50.
Accessory: RF crystal diode probe kit extends RF range to 100 Mc., No. 309, \$6.50.

New Heathkit HANDITESTER KIT

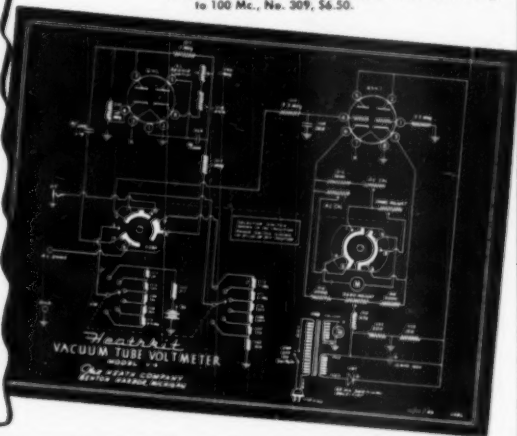
Features

- Beautiful streamline Bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 Microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
- All the convenient ranges 10-30-300-1,000-5,000 Volts.
- Large quality 3" built-in meter.

A precision portable volt-ohm-milliammeter. An ideal instrument for students, radio service, experimenters, hobbyists, electricians, mechanics, etc. Rugged 400 ua meter movement. Twelve complete ranges, precision divider for accuracy. Easily assembled from complete instructions and pictorial diagrams. An hour of assembly saves one-half the cost. Order today. Model M-1. Shipping wgt., 2 lbs.



\$13⁵⁰

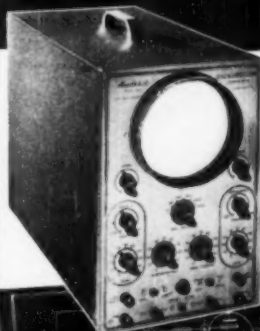


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The HEATH COMPANY

... BENTON HARBOR 15, MICHIGAN

TEST INSTRUMENT KITS



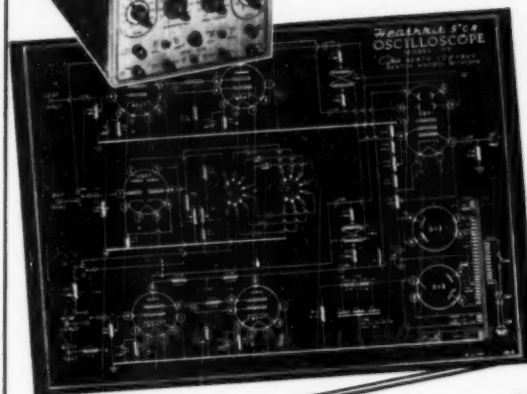
Only
\$39⁵⁰

Heathkit PUSH-PULL EXTENDED RANGE 5" OSCILLOSCOPE KIT

Features

- The first truly television oscilloscope.
- Tremendous sensitivity. 86 Volt RMS per inch deflection.
- Push-pull vertical and horizontal amplifiers.
- Useful frequency range to 25.5 Megacycles.
- Extended sweep range 15 cycles to 70,000 cycles.
- New television type multivibrator sweep generator.
- New magnetic alloy shield included.
- Still the amazing price of \$39.50.

The new 1950 Push-Pull 5" Oscilloscope has features that seem impossible in a \$39.50 oscilloscope. Think of it—push-pull vertical and horizontal amplifiers with tremendous sensitivity only six one-hundredths of a volt required for full inch of deflection. The weak impulses of television can be boosted to full size on the five-inch screen. Traces you couldn't see before. Amazing frequency range, clear, useful response at 25.5 Megacycles made possible by improved push-pull amplifiers. Only Heathkit Oscilloscopes have the frequency range required for television. New type multivibrator sweep generator with more than twice the frequency range, 15 cycles to 70,000 cycles will actually synchronize with 250,000 cycle signal. Dual positioning controls will move trace over any section of the screen for observation of any part. New magnetic alloy CR tube shield protects the instrument from outside fields. All the same high quality parts, cast electrostatically shielded power transformer, aluminum cabinet, all tubes and parts. New instruction manual now has complete step-by-step pictorials for easiest assembly. Shipping weight, 25 lbs. Model O-5



Heathkit

ELECTRONIC SWITCH KIT

DOUBLE THE UTILITY OF ANY SCOPE

An electronic switch used with any oscilloscope provides two separately controllable traces on the screen. Each trace is controlled independently and the position of the traces may be varied. The input and output traces of an amplifier may be observed one above the other or one directly over the other illustrating perfectly any change occurring in the amplifier. Distortion-phase shift and other defects show up instantly. 110V, 60 cycle transformer operated. Uses 5 tubes (1 6X5, 2 6SN7's, 2 6SJ7's). Has individual gain controls, positioning control and coarse and fine switching rate controls. The cabinet and panel match all other Heathkits. Every part supplied including detailed instructions for assembly and use. Shipping weight 11 lbs. Model S-1

\$34⁵⁰



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The HEATH COMPANY

... BENTON HARBOR 15, MICHIGAN

March, 1950

71

Heathkits ENABLE THE BUILDER

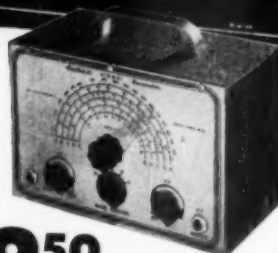
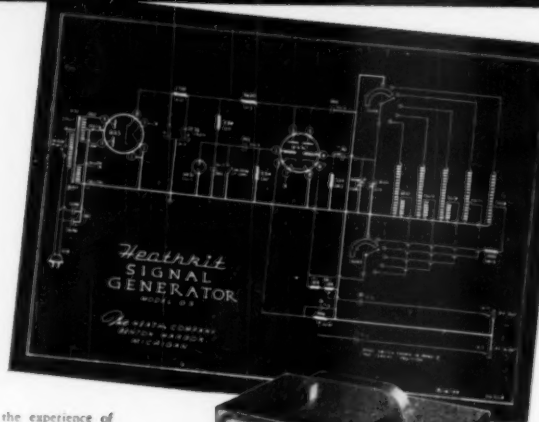
By assembling your own laboratory equipment,
you control the quality of workmanship and
learn the entire uses of the instrument.

New 1950 VERNIER TUNING RF Heathkit SIGNAL GENERATOR KIT Features

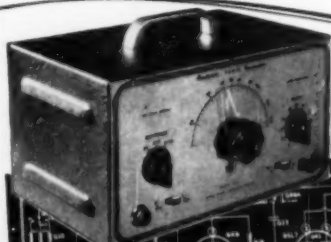
- New 5-to-1 ratio vernier tuning for ease and accuracy.
- New external modulation switch — use it for fidelity testing.
- Covers 150 Kc. to 34 Mc. on fundamentals and calibrated strong harmonics to 102 Mc.
- 400 cycle audio available for audio testing.
- Most modern type R.F. oscillator.
- New precision coils for greater output.
- Cathode follower output for greatest stability.

The most popular signal generator kit has been vastly improved — the experience of thousands combined to give you the best. Check the features in this fine generator and consider the low price \$19.50. A best buy for any shop, yet inexpensive enough for hobbyists. Everyone can have an accurate controlled source of R.F. signal voltage.

The new features double the value — think of being able to make fidelity checks on receivers by inserting a variable audio signal. Internal 400 cycle saw-tooth audio oscillator modulates R.F. signal and is available externally for audio testing. The new 5-to-1 ratio vernier drive gives hairline tuning for maximum accuracy in scale settings. The coils are already precision wound and calibrated. Uses turret type coil and switch assembly for ease of construction. The generator is 110V. 60 cycle transformer operated and comes complete in every detail — cabinet, tubes, beautiful two color calibrated panel and all small parts — new step-by-step pictorial diagrams and complete instruction manual make assembly a cinch even for novices. Why try to get along without a signal generator when you can have the best for less than a twenty-dollar bill. Better order it now. Shipping weight, 7 lbs. Model G-5.



\$19.50



\$34.50

Heathkit SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Experimenters and servicemen working with a square wave for the first time invariably wonder why it was not introduced before. The characteristics of an amplifier can be determined in seconds compared to several hours of tedious plotting using older methods. Stage by stage, amplifier testing is as easy as signal tracing. The low distortion (less than 1%) and linear output (\pm one db) make this Heathkit equal or superior to factory built equipment selling for three or four times its price. The circuit is the popular RC tuning circuit using a four gang variable condenser. Three ranges 20-200, 200-2,000, 2,000-20,000 cycles are provided by selector switch. Either sine or square waves instantly available at slide switch. All components are of highest quality, cased 110V. 60 cycle power transformer. Mallory F.P. filter condensers, 5 tubes, calibrated two-color panel, grey crackle aluminum cabinet. The detailed instructions make assembly an interesting and instructive few hours. Shipping weight, 12 lbs. Model G-2.

Nothing ELSE TO BUY

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TO USE THE *Best* OF WORKMANSHIP

Heathkit TUBE CHECKER KIT

Features

1. Measures each element individually.
2. Has gear driven roller chart.
3. Has lever switching for speed.
4. Complete range of filament voltages.
5. Uses latest type lever switches.
7. Uses beautiful shatterproof full view meter.
8. Large size 11" x 14" x 4" complete.
9. Checks new 9 pin miniatures.

Check the features and you will realize that this Heathkit has all the features you want. Speed, simplicity, beauty, protection against obsolescence. The most modern type of tester — measures each element — beautiful Bad-Good scale, high quality meter — the best of parts — rugged oversize 110V. 60 cycle power transformer — finest of Mallory switches — Centralab controls — quality wood cabinet — complete set of sockets for all type tubes including blank spare for future types — fast action gear driven roller chart uses brass gears to quickly locate and set up any type tube. Simplified switching cuts necessary time to minimum and saves valuable service time. Short and open element check. No matter what arrangement of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker today. See for yourself that Heath again saves you two-thirds and yet retains all the quality — this tube checker will pay for itself in a few weeks — better build it now.

Complete with detailed instructions, all parts, cabinet, roller chart, ready to wire up and operate. Shipping weight, 12 lbs. Model TC-1.

Nothing
ELSE
TO BUY

Only \$29⁵⁰

Heathkit BATTERY ELIMINATOR KIT

Now a bench 6 Volt power supply kit for all auto radio testing. Supplies 5-7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. A well filtered rugged power supply, uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter. 0-15 Volt meter indicates output. Output variable in eight steps. Excellent for demonstrating auto radios. Ideal for servicing — can be lowered to find sticky vibrators or stepped up to equivalent of generator overload — easily constructed in less than two hours. Complete in every respect. Shipping wgt., 19 lbs.

Model BE-1

Nothing ELSE TO BUY

\$22⁵⁰



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... BENTON HARBOR 15, MICHIGAN

March, 1950

73

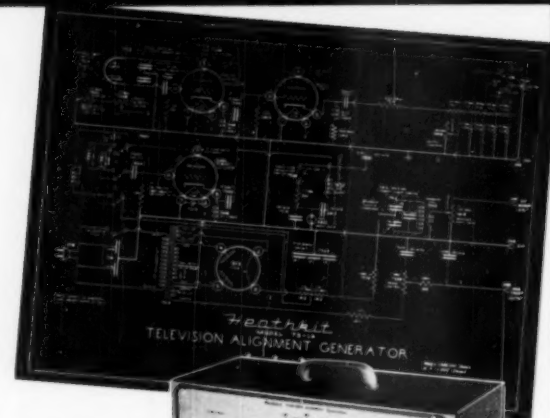
Heathkits ELIMINATE



Heathkits come complete with gray crackle painted aluminum cabinets and attractive bright cadmium plated formed chassis for professional appearance.

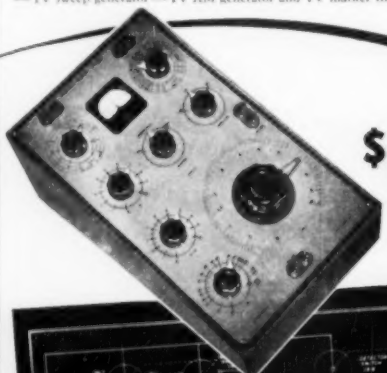
Heathkit TELEVISION ALIGNMENT GENERATOR KIT

Everything you want in a television alignment generator. A wide band sweep generator covering all TV frequencies 0 to 46 — 54 to 100 — 174 to 220 Megacycles, a marker indicator covering 19 to 42 Megacycles, AM modulation for RF alignment — variable calibrated sweep width 0-50 Mc. — mechanical driven inductive sweep. Husky 110V, 60 cycle power transformer operated — step type output attenuator with 10,000 to 1 range — high output on all ranges — band switching for each range — vernier driven main calibrated dial with over 45 inches of calibration — vernier driven calibrated indicator marker tuning. Large grey crackle cabinet 16 1/2" x 10 1/2" x 7 1/2" 1/16". Phase control for single trace adjustment. Uses three high frequency triodes plus 5Y3 rectifier — split stator tuning condensers for greater efficiency and accuracy at high frequencies — this Heathkit is complete and adequate for every alignment need and is supplied with every part — cabinet, calibrated panel, all coils and condensers wound, calibrated and adjusted, tubes, transformer, test leads — every part with instruction manual for assembly and use. Actually three instruments in one — TV sweep generator — TV AM generator and TV marker indicator.



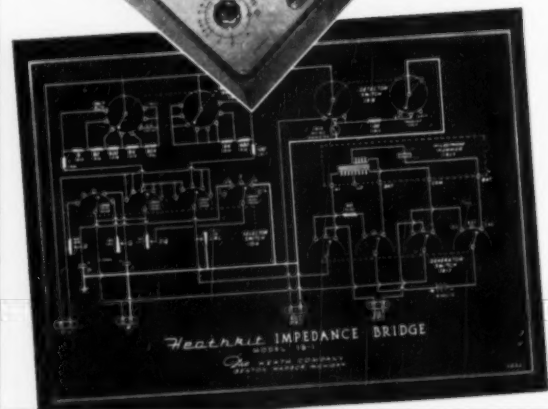
\$39.50

Shipping weight 20 lbs.
Model TS-1A



\$69.50

Shipping weight 15 lbs.
Model IB-1



New Heathkit

IMPEDANCE BRIDGE KIT

A LABORATORY INSTRUMENT NOW WITHIN
THE PRICE RANGE OF ALL

Measures inductance from 10 microhenries to 100 henries capacitance from 00001 MFD. to 100 MFD Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1000. Ideal for schools, laboratories, service shops, serious experimenters.

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimenters and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 microamp zero center galvanometer — 1% of 1% ceramic non-inductive decade resistors. Professional type binding posts with standard 1/4" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of Silver Mica, accurate to 1% of 1% and with dissipation factors of less than .001 parts in one million. Provisions on panel for external generator and detector. Measure all your unknown the way laboratories do — with a bridge for accuracy and speed.

Internal 6 Volt battery for resistance and hummer operation. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited.

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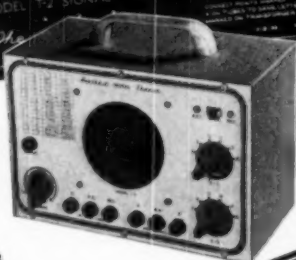
The HEATH COMPANY

... BENTON HARBOR 15, MICHIGAN

DIFFICULT METAL FABRICATION....



\$19.50

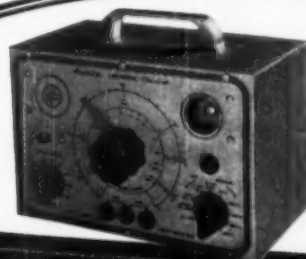


*Nothing
ELSE TO BUY*

NEW *Heathkit* SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker, locates intermittents, defective parts quicker, saves valuable service time, gives greater income per service hour. Works equally well on broadcast, FM or TV receivers. The test speaker has assortment of switching ranges to match push-pull or single output impedance. Also tests microphones, pickups, PA systems; comes complete — cabinet, 110V, 60 cycle power transformer, tubes, test probe — all parts and detailed instructions for assembly and use. Shipping Wt., 8 lbs. Model T-2.

\$19.50

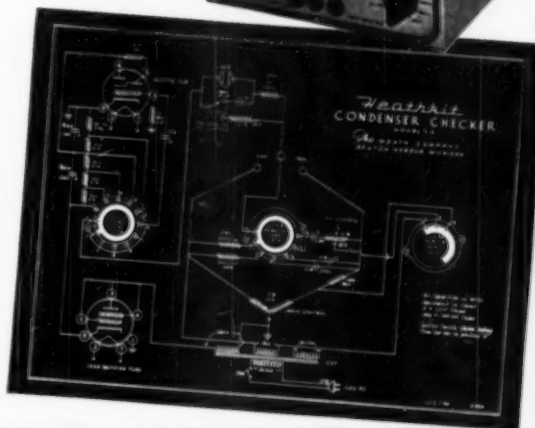


Heathkit CONDENSER CHECKER KIT

Features

- Power factor scale
- Measures resistance
- Measures leakage
- Checks paper-mica-electrolytics
- Bridge type circuit
- Magic eye indicator
- 110V. transformer operated
- All scales on panel

Checks all types of condensers, paper-mica-electrolytic-ceramic over a range of .00001 MFD. to 1000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read without a college education. A leakage test and polarizing voltage for 20 to 500 volts provided. Measures power factor of electrolytics between 0% and 50%. 110V. 60 cycle transformer operated complete with rectifier and magic eye tubes, cabinet, calibrated panel, test leads and all other parts. Clear detailed instruction for assembly and use. Why guess at the quality and capacity of a condenser when you can know for less than a twenty dollar bill. Shipping weight, 7 lbs. Model C-2.



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The HEATH COMPANY

... BENTON HARBOR 15, MICHIGAN

March, 1950

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The GREATEST TELEVISION *Buy!*

A 18 TUBE *Complete* TV RECEIVER KIT

WITH 12 CHANNEL TUNER
Actually LESS THAN COST
OF TUNER ALONE

\$34.50

less
TUBES
AND
CABINET



COMPLETELY ASSEMBLED 5000 VOLT PICTURE TUBE POWER SUPPLY

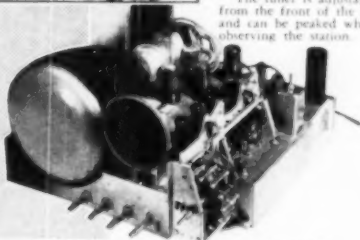
This husky 5000 volt supply provides adequate voltage for the picture tube and gives perfect black and white reproduction. It is of the R.F. type and comes complete with the 50L6 R.F. oscillator and the 1B3 rectifier tubes installed.



COMPLETELY ASSEMBLED 12 CHANNEL TUNER

One of the finest tuners available is supplied completely assembled. The tuner has three permeability tuned circuits for both the high and low bands. A 6BH6 is used as R.F. amplifier while a 6J6 twin triode operates as mixer and oscillator.

The tuner is adjustable from the front of the set and can be peaked while observing the station.



This quality TV receiver uses latest type miniature television tubes 6AG5 - 6BH6, etc. The chassis comes complete with all brackets, CR tube mounting, I.F. coils, speaker — everything to build a powerful factory quality television receiver.

Think of it. A beautiful factory engineered 18 tube television receiver with all parts (less tubes and cabinet) for the cost of the tuner alone, \$34.50. Now you can afford to learn the fascinating secret of this new industry by actually assembling a high quality receiver. This TV receiver kit has everything, 12 channel Defiance tuner using 6BH6 RF stage and 6J6 as oscillator and mixer, all assembled and adjusted. Completely assembled 5000 Volt high voltage power supply ready to operate. A circuit incorporating the latest developments. The panel controls are station selector, volume, vertical and horizontal hold and contrast. At the rear are brightness, vertical and horizontal size, focus, vertical and horizontal centering. The circuit uses three stages of high gain I.F. with 6AG5 tubes, 12AU6 limiter, 6AL5 second detector, 12AU6 syn. separator, 12AU6 video amplifier, 12SN7 horizontal multivibrator, 50L6 horizontal output, 12SN7 vertical multivibrator, 12SN7 vertical output, 50L6 high voltage oscillator, 1B3 high voltage rectifier, 19T8 as FM detector and audio amplifier, 25L6 audio output.

The cadmium plated chassis is punched and formed ready to assemble — every coil, condenser, resistor supplied. Comes complete with large (18 x 24) pictorial and manufacturer's instruction manual.

BEAUTIFUL STYLING

This modern beautifully styled TV receiver will bring untold pleasure and entertainment to the entire family. The pleasant appearance compliments any living room while the steadily improving programs will please the entire family. There are excellent vaudeville programs to entertain your friends, excellent children's programs, Arthur Godfrey, United Nations programs for serious thinkers. A television set aids in the education of the family and by building its vast technical knowledge of this new profitable field is obtained.

Remember we have a limited quantity. Order now while still available.

- | | |
|-------------------------------------------------------------------------------------------------------------------|---------|
| Complete 7" Television Receiver Kit
(less tubes and cabinet) | \$34.50 |
| Complete set of tubes as outlined above with RCA 7JP4 picture tube (18 tubes for less than price of picture tube) | 20.00 |
| Beautiful piano finish mahogany cabinet for above TV set | 20.00 |
| Buy all at one time and save. Complete Receiver Kit with tubes and cabinet | 69.50 |

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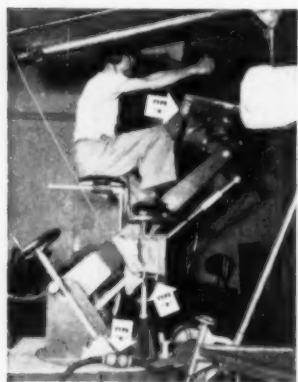
The HEATH COMPANY

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KEEP UP WITH CANNON

...get on the gratis subscription list of "The Cannon Electric Cannoneer" bi-monthly, eight-page, technical house organ and preview of Cannon Plugs, news and information about all Cannon Electric products.



PLUGS ON VIDEO CAMERA

...be assured of "good connections." That's why television stations, for instance, use Cannon Electric Type K, P, and other series for cameras, microphones and transmission equipment that must not fail. Shown above is a camera at KTLA—Hollywood.

Cannon Plugs are available through a network of radio parts dealers all over the U.S.A. Buy them from Rochester Radio Supply, Rochester, N. Y.; Warren Radio, Sioux Falls, N. D.; Electra Dist., Nashville, Tenn.; Radio Specialties, Detroit; The Hargis Co., Austin, Tex.; Radio & Electronic Parts, Cleveland; and more than 400 other radio parts distributors. Write for new C-48

Condensed General Catalog.

Cannon Electric Development Company, Division of Cannon Manufacturing Corporation, 3209 Humboldt Street, Los Angeles 31, California. Canadian factory: Toronto. World Export: Frazer & Hansen, San Francisco, New York, Los Angeles.

CANNON ELECTRIC



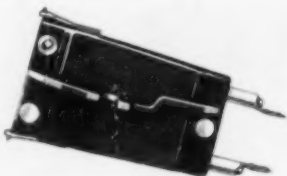
What's New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

UNIVERSAL CARTRIDGE

A new universal cartridge, the "Featheride" Type A1, which will fit almost all record changer arms and play any combination of record speeds has been announced by Webster Electric Company of Racine, Wisconsin.

The cartridge measures 19/32" wide



by 1" long which makes it suitable for most of the modern designed tone arms. Tracking pressure is 7 grams, meeting the requirements of 33 1/3 and 45 r.p.m. record speeds and providing unusually light tracking in the playing of standard 78 r.p.m. records.

Needles are held firmly in position by specially designed friction chucks.

CROSSOVER NETWORK

University Loudspeakers, Inc. of 80 South Kensico Avenue, White Plains, New York has announced a new filter network of the LC type for use with coaxial or duplex loudspeaker systems.

Designated the Model 4410 filter, this high fidelity accessory provides a proper attenuation rate at a crossover of 600 cycles. The new unit is housed in a cast aluminum container which is compact and carefully finished throughout. A high frequency attenu-



ator is supplied with this network for properly balancing the low and high frequencies.

SPRAGUE CONDENSERS

A line of electrolytic condensers for 115-volt continuous duty alternating current service is a new development of the Sprague Electric Company of North Adams, Massachusetts.

Known as the Sprague Type 11A, these units are suited for cross-the-line power factor improvement at low voltages, particularly with appliances and light industrial equipment. They may be used in applications where starting voltage surges across condensers may exceed rated voltages by as much as 50 per-cent for a maximum of two seconds.

They may also be used in applications where a voltage drop is required without power dissipation. An engineering bulletin (No. 301) is available on this line when requests are made on company letterhead.

EMC "VOLOMETER"

Electronic Measurements Corporation, 423 Broome Street, New York 13, New York, has developed a new com-



compact and lightweight multimeter, the Model 104 "Volometer."

Although inexpensively priced, the new unit has such features as 4 1/2" square, 50 microampere meter with Alnico magnet, three a.c. current ranges to 3 amperes, three resistance ranges to 20 megohms, five d.c. voltage ranges at 20,000 ohms/volt to 3000 volts, and five a.c. voltage ranges to 3000 volts.

The instrument, which is housed in a high-impact, round-cornered Bakelite case with carrying strap, measures 5 1/4" x 6 1/4" x 2 3/8" and weighs only 2 pounds and 5 ounces.

3-INCH CR TUBE

A new three-inch cathode-ray tube, said to be the shortest electrostatic tube of its classification made in the United States, has been announced by the Tube Divisions of the General Electric Company.

Designated the 3MP1, it was originally designed for use in small indus-

RADIO & TELEVISION NEWS



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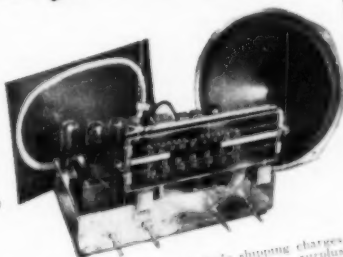
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PASTE COUPON ON PENNY POSTCARD

March, 1950

trial oscilloscopes. The new tube is expected to find numerous applications for television servicing and for



testing industrial apparatus such as welders, amplifiers, and electronic timing devices.

Special processing of the screen gives a brighter trace than normal tubes of the same electrical ratings, according to the company. The new tube is an electrostatic focus and deflection type with a bulb diameter of 3 1/4 inches and a useful screen diameter of 2 1/4 inches. It is equipped with a small-shell, duodecal base which has been set as the standard base on all television tube types.

Maximum ratings for the new tube are available from the company's Tube Divisions at Schenectady, New York, along with other pertinent data on the 3MP1.

PLYWOOD MAST

A new sectional mast which is capable of supporting a television re-

ceiver antenna up to 90 feet above the ground has been introduced by *Special Purpose Products Co.*, 135 Perry Street, New York 14, New York.

Available in kit form, these masts are of a special plywood tubing, Woundwood, which has been designed especially for such purposes. Parts for a 60-foot antenna mast include Woundwood sections for mast and erection boom, guy lines, block and fall, base, boom socket and stakes.

The lead wires are protected inside of the hollow core of the mast, which is weather-resistant and non-rusting.

GROUND CLAMPS

Of interest to service technicians and amateurs is the new adjustable ground clamp recently announced by *Blackburn Specialty Co.*, 6541 Euclid Ave., Cleveland 3, Ohio.

The clamp is now available in two sizes, one to fit 1/2" to 1 1/4" pipe and the other to fit 1/2" to 3" pipe. A tightening screw chafes the pipe, draws up slack, cuts through rust and dirt and at the same time contracts the band around the pipe surface, assuring a perfect ground.

Solder or solderless terminal types are available for various applications. The clamp itself consists of a flexible, perforated pure copper band which encircles the pipe. A boss raised on the flat end of a removable copper alloy terminal lug fits into band holes and is machined to give a clean and

smooth contact surface. The tightening screw with a lock nut is threaded through the boss. The clamp carries *Underwriters' Laboratories* approval.

NEW-TYPE TAPE RECORDER

A new tape recorder, which is being marketed under the trade name "Reelast," has been introduced by *Universal Moulded Products Corporation* of 1500 Walnut Street, Philadelphia 2, Pennsylvania.

Some of the unit's exclusive new features include twin-track recording without interruption for rewinding; no "flip-flop" of reels as a patented "Revers-A-Matic" plays or records in two directions for one hour without



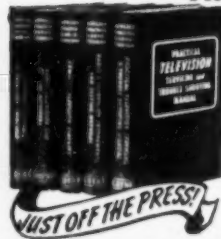
attention; a new "Thred-A-Matic" feature which simplifies threading of tape; and a volume indicator (an elec-

(Continued on page 134)

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with constantly suspended 3"
V magnet with 1" voice coil
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A-50

Model
A-50
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shower set, 1.5 (10)

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7 lbs. Why pay 15
Every speaker guar
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McIntosh's model 1202-X, 12" watt 14.4" voice coil Alnico V speaker, Model 1202-X has 12" Alnico V ring magnet and 14.4" x 8 ohm voice coil. One polished eucalyptus cone forms trumpet for high note distortion. Ideal for high fidelity music reproduction, rugged public address work. Made especially for us, our own specifications by a famous builder of speakers. Frequency response is from 35 to 12,500 c/s metal pot cover. Shipping weight is 26 lbs. for some other heavy duty speaker \$29.50 list. \$19.95, 2 for \$36.95. 3 for \$51.95.

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[illegible]

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THEATRE QUALITY
20-20,000 CPS
AMP. KIT \$2995**
Mike, Crystal, and
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20 WATTS
10 WATT MODEL . . . \$19.95
 Here are the two best amplifier
 kit values in the United States
 20 and 30 watt models that will

When wired, everything looks like a manufactured job. The chassis has a sturdy metal frame, and the wiring is clean and correct. Inputs for 2 linkers (constant or dynamic) and crystal phono pickup. Compact chassis size, 6 1/8 x 1 7/8 x 1 1/2 inches. Includes all components and mounting hardware. Plans for easy wiring. Frequency response, 20 to 12,500 CPS. Dealers, you can build your own amplifier for less than \$100. You will need a power supply tube, 6X4, 6BE6, 6BN7, 2-12AX7 and 1-6. You will need a transformer output 4-6-16 and 250v ohms. A complete kit, Shipping included, \$19.95. Add \$2.00 per tube. Tubes are 2Z3-30, 2Z3-30, 20 watt amplifier kit, with tubes - 2-6JG6, 6BN7, 2-12AX7, 5Y4 and 6SN7. 200 mill power transformer Output 4-6-16-250 and 500v ohms. Complete kit, Shipping included, \$19.95.

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Model 600—A standard replacement for half V.C.

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KIT**

This amplifier kit, when wired, may be used as a musical amplifier, guitar amplifier or for any other low power P.A. use.

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


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Mac's Service Shop

(Continued from page 60)

ticular job for them that they cannot do for themselves, just as they depend on their doctor, dentist, auto mechanic, or jeweler. In short, we have elected to serve the people, with all that big word implies.

"If we are going to serve them well, we have to have a genuine interest in them and their problems. If we have no such interest, we had better get into some other more impersonal business; for while the average person is a very poor judge of radio service work, he is not nearly so dumb about human nature. He may not notice the improvement that your realignment job produced in his set, but he can spot the old brushoff a mile away."

"Then you don't hold with the idea that if you are a super-duper technician the world will seek you out and overwhelm you with business."

"Not by a long shot. I doubt that a man can make a continued success of radio servicing unless he is a good technician; but I know that a good technician can be a flat failure unless he has the knack of making people like and trust him.

"The main idea in the radio service business is the same as that in the famous recipe for rabbit stew that starts out: 'First, catch a rabbit.' The first thing we have to do is to catch and keep customers; yet, being the technical-minded nuts we are, a lot of us get so wrapped up in actually fixing sets and in trying to keep up with the new developments in this galloping field of ours that we neglect our 'customer-relations.' In fact, we go so far as to feel and show actual annoyance when a customer comes in and makes us leave the bench just when we are hot on the trail of an elusive intermittent.

"But I am just wasting my breath. I doubt that you have even the foggiest idea of what I am trying to tell you."

"I resent that—bitterly!" Barney replied as he drew his lanky figure to its full height and looked disdainfully down at Mac. "Just to show you what a grave injustice you have done me, I shall point out that you have spent the greater part of the last quarter of an hour explaining in needless detail What Every Girl Should Know."

"What Every Girl Should Know!" Mac repeated in blank amazement. "How on earth did you ever get that crackpot idea?"

"What Every Girl Should Know: How to say, 'No.' Barney explained as he started sidling toward the service department door.

Only his youthful agility enabled him to dart through the opening and slam the door behind him before the copy of Turner's "Radio Test Instruments," the first weapon that came to Mac's hand, crashed against the jamb.

—30—

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Profit by these spectacular values! We're clearing our warehouse to make room for incoming stock! Everything goes!

OIL CONDENSERS—DC RATINGS

2x1	2x2	2x3	2x4	2x5	2x6	2x7	2x8	2x9	2x10	2x11	2x12	2x13	2x14	2x15	2x16	2x17	2x18	2x19	2x20	2x21	2x22	2x23	2x24	2x25	2x26	2x27	2x28	2x29	2x30	2x31	2x32	2x33	2x34	2x35	2x36	2x37	2x38	2x39	2x40	2x41	2x42	2x43	2x44	2x45	2x46	2x47	2x48	2x49	2x50	2x51	2x52	2x53	2x54	2x55	2x56	2x57	2x58	2x59	2x60	2x61	2x62	2x63	2x64	2x65	2x66	2x67	2x68	2x69	2x70	2x71	2x72	2x73	2x74	2x75	2x76	2x77	2x78	2x79	2x80	2x81	2x82	2x83	2x84	2x85	2x86	2x87	2x88	2x89	2x90	2x91	2x92	2x93	2x94	2x95	2x96	2x97	2x98	2x99	2x100	2x101	2x102	2x103	2x104	2x105	2x106	2x107	2x108	2x109	2x110	2x111	2x112	2x113	2x114	2x115	2x116	2x117	2x118	2x119	2x120	2x121	2x122	2x123	2x124	2x125	2x126	2x127	2x128	2x129	2x130	2x131	2x132	2x133	2x134	2x135	2x136	2x137	2x138	2x139	2x140	2x141	2x142	2x143	2x144	2x145	2x146	2x147	2x148	2x149	2x150	2x151	2x152	2x153	2x154	2x155	2x156	2x157	2x158	2x159	2x160	2x161	2x162	2x163	2x164	2x165	2x166	2x167	2x168	2x169	2x170	2x171	2x172	2x173	2x174	2x175	2x176	2x177	2x178	2x179	2x180	2x181	2x182	2x183	2x184	2x185	2x186	2x187	2x188	2x189	2x190	2x191	2x192	2x193	2x194	2x195	2x196	2x197	2x198	2x199	2x200	2x201	2x202	2x203	2x204	2x205	2x206	2x207	2x208	2x209	2x210	2x211	2x212	2x213	2x214	2x215	2x216	2x217	2x218	2x219	2x220	2x221	2x222	2x223	2x224	2x225	2x226	2x227	2x228	2x229	2x230	2x231	2x232	2x233	2x234	2x235	2x236	2x237	2x238	2x239	2x240	2x241	2x242	2x243	2x244	2x245	2x246	2x247	2x248	2x249	2x250	2x251	2x252	2x253	2x254	2x255	2x256	2x257	2x258	2x259	2x260	2x261	2x262	2x263	2x264	2x265	2x266	2x267	2x268	2x269	2x270	2x271	2x272	2x273	2x274	2x275	2x276	2x277	2x278	2x279	2x280	2x281	2x282	2x283	2x284	2x285	2x286	2x287	2x288	2x289	2x290	2x291	2x292	2x293	2x294	2x295	2x296	2x297	2x298	2x299	2x300	2x301	2x302	2x303	2x304	2x305	2x306	2x307	2x308	2x309	2x310	2x311	2x312	2x313	2x314	2x315	2x316	2x317	2x318	2x319	2x320	2x321	2x322	2x323	2x324	2x325	2x326	2x327	2x328	2x329	2x330	2x331	2x332	2x333	2x334	2x335	2x336	2x337	2x338	2x339	2x340	2x341	2x342	2x343	2x344	2x345	2x346	2x347	2x348	2x349	2x350	2x351	2x352	2x353	2x354	2x355	2x356	2x357	2x358	2x359	2x360	2x361	2x362	2x363	2x364	2x365	2x366	2x367	2x368	2x369	2x370	2x371	2x372	2x373	2x374	2x375	2x376	2x377	2x378	2x379	2x380	2x381	2x382	2x383	2x384	2x385	2x386	2x387	2x388	2x389	2x390	2x391	2x392	2x393	2x394	2x395	2x396	2x397	2x398	2x399	2x400	2x401	2x402	2x403	2x404	2x405	2x406	2x407	2x408	2x409	2x410	2x411	2x412	2x413	2x414	2x415	2x416	2x417	2x418	2x419	2x420	2x421	2x422	2x423	2x424	2x425	2x426	2x427	2x428	2x429	2x430	2x431	2x432	2x433	2x434	2x435	2x436	2x437	2x438	2x439	2x440	2x441	2x442	2x443	2x444	2x445	2x446	2x447	2x448	2x449	2x450	2x451	2x452	2x453	2x454	2x455	2x456	2x457	2x458	2x459	2x460	2x461	2x462	2x463	2x464	2x465	2x466	2x467	2x468	2x469	2x470	2x471	2x472	2x473	2x474	2x475	2x476	2x477	2x478	2x479	2x480	2x481	2x482	2x483	2x484	2x485	2x486	2x487	2x488	2x489	2x490	2x491	2x492	2x493	2x494	2x495	2x496	2x497	2x498	2x499	2x500	2x501	2x502	2x503	2x504	2x505	2x506	2x507	2x508	2x509	2x510	2x511	2x512	2x513	2x514	2x515	2x516	2x517	2x518	2x519	2x520	2x521	2x522	2x523	2x524	2x525	2x526	2x527	2x528	2x529	2x530	2x531	2x532	2x533	2x534	2x535	2x536	2x537	2x538	2x539	2x540	2x541	2x542	2x543	2x544	2x545	2x546	2x547	2x548	2x549	2x550	2x551	2x552	2x553	2x554	2x555	2x556	2x557	2x558	2x559	2x560	2x561	2x562	2x563	2x564	2x565	2x566	2x567	2x568	2x569	2x570	2x571	2x572	2x573	2x574	2x575	2x576	2x577	2x578	2x579	2x580	2x581	2x582	2x583	2x584	2x585	2x586	2x587	2x588	2x589	2x590	2x591	2x592	2x593	2x594	2x595	2x596	2x597	2x598	2x599	2x600	2x601	2x602	2x603	2x604	2x605	2x606	2x607	2x608	2x609	2x610	2x611	2x612	2x613	2x614	2x615	2x616	2x617	2x618	2x619	2x620	2x621	2x622	2x623	2x624	2x625	2x626	2x627	2x628	2x629	2x630	2x631	2x632	2x633	2x634	2x635	2x636	2x637	2x638	2x639	2x640	2x641	2x642	2x643	2x644	2x645	2x646	2x647	2x648	2x649	2x650	2x651	2x652	2x653	2x654	2x655	2x656	2x657	2x658	2x659	2x660	2x661	2x662	2x663	2x664	2x665	2x666	2x667	2x668	2x669	2x670	2x671	2x672	2x673	2x674	2x675	2x676	2x677	2x678	2x679	2x680	2x681	2x682	2x683	2x684	2x685	2x686	2x687	2x688	2x689	2x690	2x691	2x692	2x693	2x694	2x695	2x696	2x697	2x698	2x699	2x700	2x701	2x702	2x703	2x704	2x705	2x706	2x707	2x708	2x709	2x710	2x711	2x712	2x713	2x714	2x715	2x716	2x717	2x718	2x719	2x720	2x721	2x722	2x723	2x724	2x725	2x726	2x727	2x728	2x729	2x730	2x731	2x732	2x733	2x734	2x735	2x736	2x737	2x738	2x739	2x740	2x741	2x742	2x743	2x744	2x745	2x746	2x747	2x748	2x749	2x750	2x751	2x752	2x753	2x754	2x755	2x756	2x757	2x758	2x759	2x760	2x761	2x762	2x763	2x764	2x765	2x766	2x767	2x768	2x769	2x770	2x771	2x772	2x773	2x774	2x775	2x776	2x777	2x778	2x779	2x780	2x781	2x782	2x783	2x784	2x785	2x786	2x787	2x788	2x789	2x790	2x791	2x792	2x793	2x794	2x795	2x796	2x797	2x798	2x799	2x800	2x801	2x802	2x803	2x804	2x805	2x806	2x807	2x808	2x809	2x810	2x811	2x812	2x813	2x814	2x815	2x816	2x817	2x818	2x819	2x820	2x821	2x822	2x823	2x824	2x825	2x826	2x827	2x828	2x829	2x830	2x831	2x832	2x833	2x834	2x835	2x836	2x837	2x838	2x839	2x840	2x841	2x842	2x843	2x844	2x845	2x846	2x847	2x848	2x849	2x850	2x851	2x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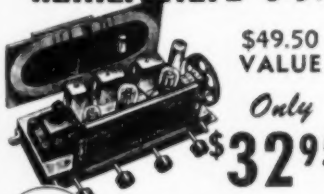
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"Lock-in" Circuit

(Continued from page 44)

takes place over quite a few cycles on either side of the frequency to which the circuits are tuned. In this particular case it is significant to note that the "tank circuit" is aperiodic. Since this means that there are no tuned circuits, the conversion takes place over one complete cycle, which is essential to proper operation in the type of comparator circuit required.

Next, examine the complete circuit of Fig. 2. Note that a negative scan pulse (actually a whole line) is drawn from the horizontal yoke. After passing through the phase-shifting network, R.C., it assumes the shape shown at "A." (Note the pip of the original sync is still riding the pulse.) For an enlarged drawing of "A," see Fig. 3.

This distorted pulse is injected into the diode at point "X." Mixing with the incoming sync pulse, a d.c. voltage is developed, the value of which is a function of the difference in phase between the pulses of these two sources. This voltage, varying with phase difference (brought about by the various factors which cause loss of sync in normal TV receivers), is used to control the frequency of the horizontal oscillator.

Consider point "X" in Fig. 2. The dual-diode with equal resistors R₁ and R₂ comprise a bridge circuit. Normally the voltage at "X" would be equal to voltage at ground, or zero. The distorted negative pulse entering the circuit has an a.c. waveform, due to the distorting network. However, the major lobe is still clearly negative as shown at "A."

Thus the injection at "X" is essentially negative. This causes the upper diode to conduct less heavily and the lower one more heavily, producing a net increase of positive voltage across the load (to right of point "X.") A positive voltage applied to the grid of the discharge tube of the horizontal oscillator will tend to unblock the oscillator, increasing its speed. Conversely, reducing this positive voltage will slow up the oscillator.

Now, with the hold control remaining fairly fixed, the control voltage will have to be practically instantaneous becoming more positive when the oscillator is slow and less positive (negative going) when the oscillator is fast. How is this accomplished?

Consider Fig. 3. Study the picture of one horizontal line scan. This shows a normally locked raster line with the sync pulse riding at point "Z." It could actually ride anywhere between points "M" and "N" without upsetting the oscillator, but it will tend toward point "Z" because that is the maximum (negative) point. If it rode between points "Z" and "O" it would give wrong polarity, kicking the oscillator off frequency. Once the oscillator goes off frequency for the major part of a cycle the pulse would meet the line in a

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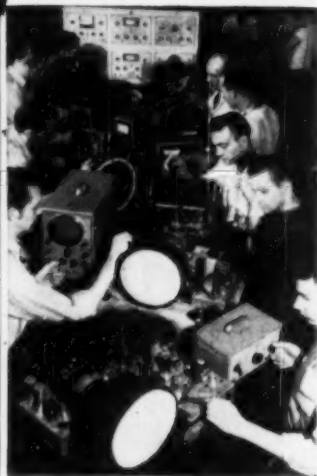
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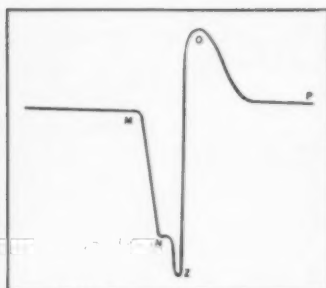


Fig. 3. Enlarged view of "A" in Fig. 2.

more favorable position since the sync pulse is rigidly controlled at the transmitter while the local horizontal oscillator is designed to lock-in when triggered by the sync pulse.)

It could ride between points "O" and "P" but that slope is too broad for sensitivity of control, and the oscillator would vary, permitting sync to strike the more favorable region "M" to "N."

Suppose the oscillator starts to speed up. If it runs away from the sync the sync pulse will start to move toward "M." This would shorten the negative peak, lowering the output voltage at point "X," slowing up the oscillator. If the action were such as to make the oscillator go too slowly, the sync would move forward to the maximum negative point at "Z," increasing the output voltage at "X," increasing the speed of the oscillator. Since the correction takes place within the cycle, the sync correction takes place within one line, causing no visible change from the standpoint of the observer.

The horizontal oscillator (not shown) is a conventional blocking oscillator in which the frequency is controlled by the time constant of the grid resistor and the grid blocking condenser. Variation of either of these two elements will control the frequency of the oscillator. (Examine the horizontal oscillator of the TV receiver it is desired to control. Any Sams Photo-fact Standard Notation Schematic of a TV receiver will clearly indicate this circuit.)

To the normal means of control of the horizontal oscillator frequency may now be added a third means of applying an automatic variable d.c. voltage to the cold end of the grid resistor. (Simply open the ground end of the resistor already in the grid circuit of the horizontal oscillator. Now connect the opened end to the output of the circuit shown in Fig. 2. The rest is automatic.)

The control voltage is derived from the reference point "X" described earlier. It passes through a filter network containing L_1 with its damping resistor, R_1 . This offers a low impedance to d.c., and a high impedance to the pulses which appear at "X." Condenser C_1 further removes any pulses which might come through L_1 . Since L_1 and C_1 comprise a series-tuned cir-

cuit, further damping is necessary. This is achieved by C_2 , a large value condenser, and its damping resistor R_2 .

Because the horizontal blocking oscillator tends to develop a high negative voltage in its grid circuit, it may be seen that this negative voltage could be reflected back to point "X", upsetting the action of the diode, if it is not balanced out.

To take care of this, resistor R_3 supplies a positive voltage to counter the negative voltage developed by the blocking oscillator. This maintains the d.c. voltage at point "X" near zero, or slightly negative. Further stabilizing may be achieved by the use of R_4 to prevent the blocking oscillator from departing too far from its normal frequency in case the synchronizing pulses from the transmitter are not present.

The author has operated the horizontal hold control on receivers using this circuit and can testify it really holds 'em!

All elements for this lock-in circuit are available in kit form from *Transvision, Inc.*, originators of this circuit. Full instructions for assembly accompany the kit. The circuit may be used with any TV receiver utilizing a horizontal blocking oscillator circuit.

-30-

Batwing FM Antenna

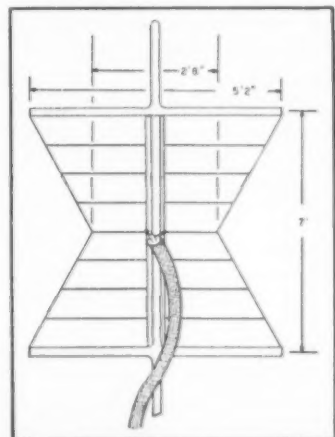
(Continued from page 35)

templated using $\frac{3}{4}$ " diameter tubing for the top and bottom members, $\frac{1}{2}$ " for the vertical members, and $\frac{3}{8}$ " for the inner horizontals—all mounted on a $\frac{3}{4}$ " mast. An antenna constructed in this manner, we believe, will yield optimum, dependable, weather-proof performance for a lifetime.

If bolted construction is used instead of the welded construction, it is advisable to use tubing and bolts of the same material to reduce the effects of electrolysis.

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Fig. 3. Dimensions of a typical batwing unit.



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"THE OSCILLOGRAPH" by Walter Weiss. Published by The Hickok Electrical Instrument Co., Cleveland, Ohio. 47 pages. Price \$1.00 (paper).

This is a thoroughly practical handbook that the radio technician can use daily in servicing radio, FM, and television receivers.

It should be emphasized that this manual is not concerned with the operation of the cathode-ray oscillograph but rather with the types of patterns that result from various service faults.

The first six sections are devoted to the subject of superheterodyne troubleshooting. For convenience sake, the author has divided the receiver into six sections; the power supply, the oscillator section, the first detector, the i.f. amplifier, the second detector and first audio section, and the final amplifier. He then outlines and illustrates the oscillograph patterns that should be obtained in a correctly functioning receiver and then the patterns which appear when the receiver is operating incorrectly.

The seventh section of the book is concerned with proper FM receiver alignment procedures to be followed when using an oscillograph for the operation and finally, a section on the proper use of an oscillograph in television receiver alignment.

A separate "Oscillograph Control Settings vs. Positions" chart is attached to the inside of the back cover where it can be easily removed for use above the oscillograph position on the service bench.

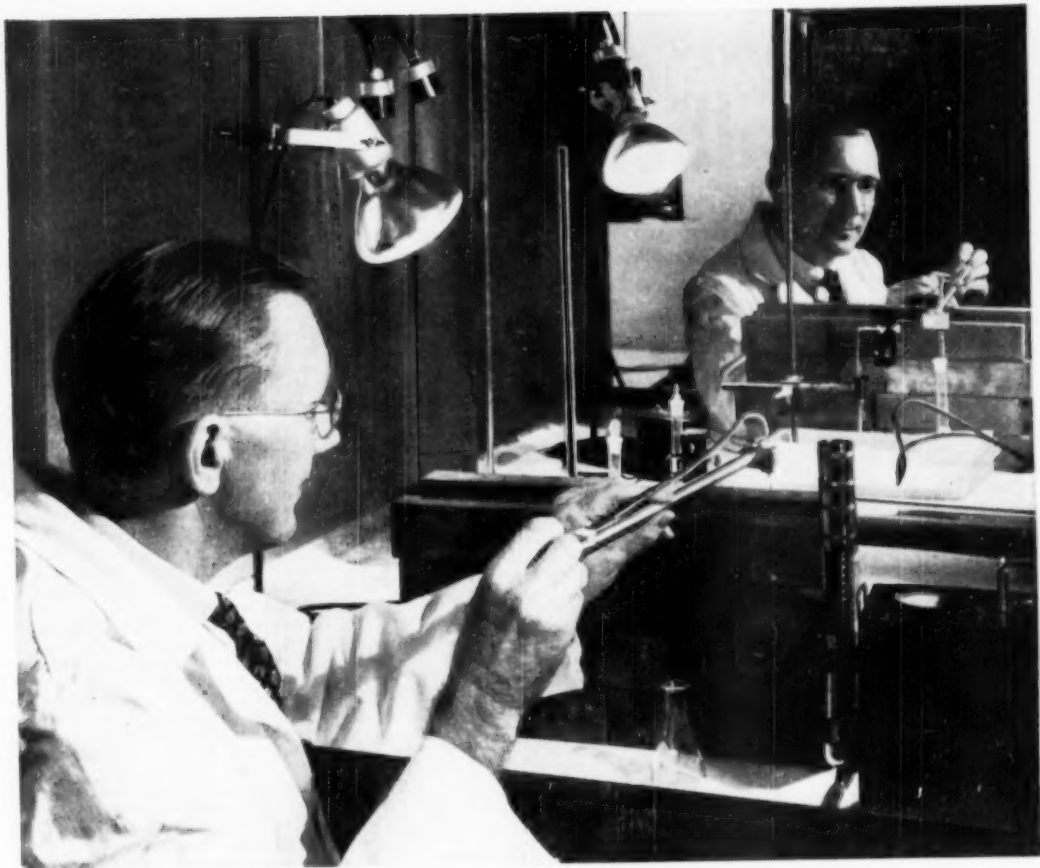
"16 MM. SOUND MOTION PICTURES" by William H. Offenhausen, Jr. Published by Interscience Publishers, Inc., New York. 565 pages. Price \$10.00.

This is a definitive work on the subject of 16 mm. films and one of the first comprehensive texts in the literature. Prior to its appearance both amateur and professional film-makers had to search many sources to find the answers to their questions and solutions to their problems.

As to the value of the photographic discussion, this reviewer is not qualified to state but the sections on sound, sound recording, sound recording characteristics and sound recording equipment and its arrangement are valuable additions to the growing library of sound and audio texts.

Although the author has more or less confined his discussion to the photographic recording and reproduction of sound, he does touch on the subject of magnetic tape and its associated recording techniques. The author discusses the general requirements as to frequency range, the influence of noise, theoretical considerations in speech and music reproduction,

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Protected by a wall of lead bricks and using a mirror to guide his instruments, this Bell Laboratories scientist is preparing a solution of a radioactive isotope, for use as a tracer to study materials for your telephone system.

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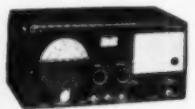
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"WORLD'S LARGEST DISTRIBUTORS OF SHORT WAVE RECEIVERS"

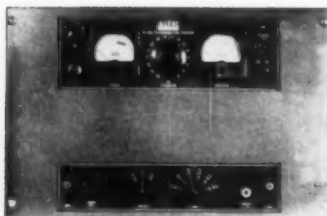
TI 401
Signal Generator



INTERMODULATION

TESTS

MADE EASY!



TI 402—Intermodulation Analyzer

An ideal tool for the design, maintenance and testing of audio devices, Altec's Intermodulation Analyzer offers distinct advantages over single-frequency "harmonic" methods of distortion measurement. Distortion products resulting from the interaction of double test frequencies are measured and read directly for any given power level. Analyzer includes VTVM, making residual noise and signal-to-noise ratio determinations possible without extra equipment. Instrument is a reliable performance index for FM and AM transmitters and receivers, all audio amplifier, disc, tape and film recording equipment.

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ALTEC

LANSING CORPORATION

practical considerations affecting the low frequency cut-off of a system, practical considerations concerning frequency range and volume range of reproduced sound, production implications of performance range requirements, factors influencing response frequency characteristics in 16 mm. sound recording, transfer steps, process of making release prints and effect on sound, general recording procedures, and practical suggestions for recording.

The chapter covering the equipment used in recording on film lists the general requirements for such equipment, transfer losses and their correction, recommended ranges of response frequency over-all characteristic, pre- and post-equalizing, details of recording equipment, and the physical placement of the various recording components.

For the amateur 16 mm. enthusiast as well as personnel of commercial film outfits, this book is a must on the reference shelf.

"FACSIMILE" by Charles R. Jones. Published by Murray Hill Books, Inc., New York. 411 pages. Price \$6.00.

This is a comprehensive work on the subject of facsimile written for the user as well as the technician who services the equipment.

The book is divided into four parts covering the nature of facsimile; its operation, present-day facsimile systems, and servicing. The first part deals with the historical and technical background of the medium, modern facsimile equipment, the type and scope of facsimile services (both projected and actual), facsimile broadcasting, and other facsimile devices.

The second part covers transmitters and transmission facilities, facsimile reception, synchronization and phasing, tape facsimile, and facsimile standards. The third part deals with the various facsimile systems now available and covers the products of such manufacturers as Acme Teletronix, Alden Products Company, A.T. & T., Finch Telecommunications, Inc., Radio Inventions, Inc., Times Facsimile Corporation, and Western Union.

The fourth part is for the service technician and deals with such subjects as exciter lamp replacement, replacing the recording element, printer blade adjustment, cleaning and lubrication, mechanical repairs, electronic maintenance, photofacsimile units, and troubleshooting the set. Detailed service notes are provided on the Finch Type FRS 140-C, and the General Electric Types FR-1 and RX23.

Both technically and non-technically trained persons will find this book of interest. Although the author is a development engineer with Finch Telecommunications, Inc., he has not fallen into the trap which so often ensnares engineer-authors and used highly technical terminology in his text. The book is thoroughly readable and informative.

-50-

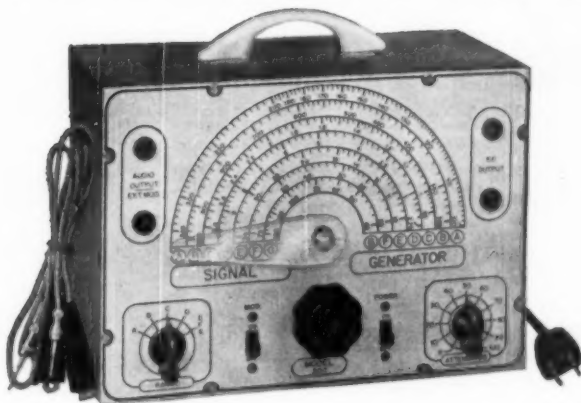
RADIO & TELEVISION NEWS

WE KNOW THE PRICE IS UNBELIEVABLY LOW,

but that's not all! In addition, this finely engineered instrument provides a degree of accuracy never before attained in a unit selling for even double this price. Furthermore in designing this unit, we took advantage of every recent improvement in components. For example, by using slug-tuned coils, we are able to efficiently adjust each instrument

for perfect accuracy. This feature will also enable you to recalibrate the model 200 periodically without having to return it to the factory. The use of a Noval tube (the 12AU7) with its extremely low inter-electrode capacity enabled us to reach a higher frequency range than was heretofore possible in a unit of this type.

THE NEW MODEL 200 **AM and FM** **SIGNAL GENERATOR**



SPECIFICATIONS

- ★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.
- ★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R. F. signal. Also available separately.
- ★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.
- ★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.
- ★ **ACCURACY:** Use of high-Q permeability tuned coils adjusted against 1/10th of 1% standards assures an accuracy of 1% on all ranges from 100 Kilocycles to 10 Megacycles and an accuracy of 2% on the higher frequencies.
- ★ **TUBES USED:** 12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 volts A.C. Comes complete with output cable and operating instructions

\$18⁸⁵
NET

—20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS (Sold on a "MONEY-BACK-IF-NOT-SATISFIED" Guarantee)—
GENERAL ELECTRONIC DISTRIBUTING CO. Dept. RN-3, 98 PARK PLACE
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Hickok Television

LINEARITY-PATTERN GENERATOR

MODEL 620



Features

- High output to 5,000 microvolts.
- Checks relative receiver sensitivity; horizontal and vertical deflection circuits.
- Permits alignment of linearity, drive, width, height, hold and horizontal AFC controls.
- Connects to receiver antenna.
- Blue hammett portable steel case.

SERVICE MAN'S INCOME BUILDER...

Provides Stable Pattern for Aligning TV Anytime... Anywhere HOME OR SHOP

• Here is the instrument for television trouble-shooting that is completely independent of station operation.

A new portable instrument especially designed to make TV Warranty Servicing simpler and more profitable.

Now you can prove to any customer in his home, by an electronic instrument that his set is properly aligned. Then, if reception is still faulty, you are able to show the receiver is not at fault. Perhaps a better antenna installation is needed. Model 620 is a compact, portable instrument built to the high HICKOK standard. Technicians who seriously considered dropping warranty servicing now use the 620 and profit by it. Ask any technician who owns one. See your jobber for complete information.

THE HICKOK ELECTRICAL INSTRUMENT CO.

10524 Dupont Avenue - Cleveland 8, Ohio

Please send me complete details on the new HICKOK 620 Television Linearity Pattern Generator

NAME _____

ADDRESS _____

CITY _____

STATE _____

BC-1068 RECEIVER

110V. 60 cycle power supply. 2 stages E.F. 2 stages R.F. 2 stages audio amplifier, regenerative detector and oscillator. Tuning indicator. Frequency range - 550-1500 Mc. Scales, grid, 2 meter or FM broadcast receiver. With 12 inch. construction and schematics on wheels.

\$19.95

G.E. TRANSFORMERS

110 V. 60 Cy. AC

Model E.T. 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, 400, 420, 440, 460, 480, 500, 520, 540, 560, 580, 600, 620, 640, 660, 680, 700, 720, 740, 760, 780, 800, 820, 840, 860, 880, 900, 920, 940, 960, 980, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2200, 2400, 2600, 2800, 3000, 3200, 3400, 3600, 3800, 4000, 4200, 4400, 4600, 4800, 5000, 5200, 5400, 5600, 5800, 6000, 6200, 6400, 6600, 6800, 7000, 7200, 7400, 7600, 7800, 8000, 8200, 8400, 8600, 8800, 9000, 9200, 9400, 9600, 9800, 10000, 11000, 12000, 13000, 14000, 15000, 16000, 17000, 18000, 19000, 20000, 22000, 24000, 26000, 28000, 30000, 32000, 34000, 36000, 38000, 40000, 42000, 44000, 46000, 48000, 50000, 52000, 54000, 56000, 58000, 60000, 62000, 64000, 66000, 68000, 70000, 72000, 74000, 76000, 78000, 80000, 82000, 84000, 86000, 88000, 90000, 92000, 94000, 96000, 98000, 100000, 110000, 120000, 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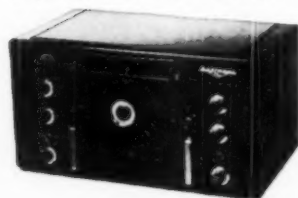
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Complete with Speaker. Ship. wt. 93 lbs. **\$375⁰⁰**
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Buy it at a substantial saving with a Walter Ashe "Surprise" Trade-in deal. What do you have to trade?



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Ship. wt. 83 lbs.
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Slash the above price by trading in your used equipment!



AMAZING NEW HALLICRAFTERS SX-71

Ship. wt. 33 lbs. **\$179⁵⁰**
Only

But buy it for less by applying our liberal trade-in allowance against the purchase price!



ELDICO TR-1 KIT

500 watts Input Transmitter kit, Phone & CW, 613 final, PP class E & H11 modulators. Complete with meter, antenna relay, microphone, tubes and final coil for one band. **\$179⁵⁰**
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THE HOUSE OF "SURPRISE" TRADE-INS
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Makes possible: — **DRASTIC
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SION SETS AND TV CUSTOM
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Trades that are longer... much longer... that's the big money saving reason why bargain-conscious folks everywhere are taking advantage of sensational savings afforded by "Surprise" allowances on used equipment. Here's how you, too, can profitably dispose of used (factory-built) equipment by trading for the brand new merchandise of your choice. Simply tell us

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YOU TO TRADE?**



what you have to trade. Indicate your preference in new equipment. Back will come our extra-liberal offer. Don't delay! Wire, write, phone or use the handy coupon — today!

Easy Terms on Your
New Equipment
Purchases

• All prices
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NEW 1950
CATALOG**

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1125 Pine St., St. Louis 1, Mo.

RN 50-3

☐ Rush Special "Surprise" Trade-in offer on my

(Describe used equipment)

for (show make and model No. new equipment desired)

☐ Send new Free 1950 Catalog.

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CITY

ZONE

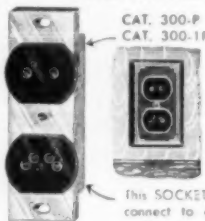
STATE

NEW!

MOSLEY FLUSH SOCKETS

1. For TV-FM-RADIO antennas and rotator controls.
2. Conceals unsightly lead-ins within walls.
3. Fits standard metal outlet boxes and single and double receptacle plates.
4. Fabricated of plastic of high dielectric and non-ferrous metals.
5. Installs as neatly as any electrical outlet.
6. Because of small entrance holes for pins of PLUGS, SOCKETS cannot be mistaken for electrical outlets.

This SOCKET designed to connect to any antenna lead-in and to receive any of MOSLEY PLUGS such as:



This SOCKET designed to connect to either 4-wire or 5-wire cable to rotator and to receive MOSLEY POLARIZED PLUGS such as CAT. 300-2P (plug portion only) and CAT. 300-5P.

FURNISHED IN 3 DESIGNS

- CAT. F-1—Single SOCKET for lead-in only.
CAT. F-14—Single SOCKET for antenna lead-in and 4-wire SOCKET for rotator control.
CAT. F-15—Single SOCKET for antenna lead-in and 5-wire SOCKET for rotator control.



CAT. 300P
Mosley Transmission Line Plug



CAT. 300-1P
For Federal Shielded K-111 Cable

CAT. 2P—4-wire Plug (Not Shown)
CAT. 5P—5-wire Plug (Not Shown)

FOR SALE AT YOUR JOBBER

MOSLEY ELECTRONIC SPECIALTIES
(WOFQY) 2125 LACKLAND ROAD
OVERLAND (IA) MISSOURI

Around the Clock (Continued from page 58)

0600	London (GOS)	GSK	26.100
		GVB	21.710
		GSH	21.470
		GSD	21.530
		GSV	17.810
		OSI	15.280
		GSO	15.180
		OSF	15.140
		GWG	15.110
		GVU	11.770
		GSD	11.750
		GVW	11.700
	Djakarta (To Asia, Australia, NA)	YDC	15.150
		YDB2	4.910
	Cebu	DYH2	6.140
	Colombo (Radio Ceylon—BBC Relay to Far East)		21.620
	Colombo (BBC ZOI Relay)		17.730
	Melbourne (RA-BBC Relay)	VLC4	15.320
	Melbourne (ABC)	VLA6	15.200
		VLC10	11.780
		VLC3	9.580
	Perth (ABC)	VLWS	9.610
		VLC2	6.130
			4.897J
	Sydney (ABC)	VL12	6.080
	Brisbane (ABC)	VLM	9.660
	(Via Pt. Moresby-ABC)	VLTS	4.917.5
			7.280
	Wellington	ZL4	15.280
	(BBC Relay)	ZL7	6.080
	Singapore (Radio Malaysia, Blue Network)		9.712
	Georgetown	ZFY	5.984A
	(BBC Relay)		
	Port-of-Spain	VP4RD	9.625
	Halifax	CHNX	6.130
	Nairobi	VQ7LO	6.057
	Hong Kong	ZBW3	9.525 V
	Kure (BFOS—BBC Relay)	WLKS	6.105
	Salzburg (BDN)		15.280
	Salzburg	ZEA	5.933 V
	(BBC Relay)		6.000
	Los Angeles	KWIX	11.860
	(AFRS-To Pacific)	KCBF	9.700
		KGEI	9.670
		KWID	9.570
		KCBA	6.120
		HP5K	6.005
	Colon	VLC4	15.320
	Melbourne (RA)	VLA6	15.200
		VLC10	11.780

(SATO)			
0600A	Colon		
0610	Melbourne		
	(RA)		
0615	Bangkok	HS3	9.796A
(NSS-M)		HS9PD	6.240A
(Daily)			
	Makings	ZNB	5.900
	Johannesburg	IV	9.870
	(SABC)	V	4.373
	Hong Kong	ZBW3	9.525 V
	London (ES-Speed)	GWR	15.300
	Dictation	OSE	11.860
	(Speed)	GWJ	9.525
	Singapore (Radio Malaysia, Blue Network to Borneo and Sarawak)		9.712
			7.200 V
			4.825
			4.778
	(Via Kuala Lumpur)		6.025
(NS)	Georgetown	ZFY	5.984A
(BO)	Salzburg (BDN)		9.533 V
	Davao		
	Mindanao	DYB2	4.985A
(NS)	Sydney	CJCK	6.010
(NS)	Toronto	CFRX	6.070
0645 (I)	Makassar	YDO	9.594
	(Comment)	YDO2	5.030
0653A	Djakarta (To Asia, Australia, NA)	YDC	15.150
		YDB2	4.910
	Karachi		11.770A
	Dacca		7.635A
	(Karachi Relay)		
	Lahore		6.075
	(Karachi Relay)		
	Tel-Aviv (Kul-Israeli)		6.830A
			6.900A
	(Via Haifa)		6.170
	Singapore		15.300
	(BFES-BBC Relay to Far East)		11.860
			9.690
			6.175
	Colombo (Radio Ceylon-BBC Relay to Far East)		21.620
			17.730
	Jogjakarta		5.098
	Stockholm	SBT	15.155
(I)	(Sweden To-SBP day-To Europe)		11.705
(NS)	Montreal	CBX	15.090

(NS)	Sydney	CJCK	6.010
(NS)	Halifax	CHNX	6.130
	Toronto	CFRX	6.070
	Los Angeles	KWIX	11.860
	(AFRS-To Pacific)	KCBF	9.700
		KGEI	9.670
		KCBA	6.120
	Tokyo (AFRS)	JKK	6.015
		JKL	4.860
	Port-of-Spain	VP4RD	9.625
	London (To Far East)	GSD	25.750
		GVT	21.750
		GSH	21.470
		OSN	11.820
0715 (NS)	Helsinki	OIX5	17.860
	(To NA)	OIX4	15.190
		OIX2	9.555
		OIX1	6.120
	Melbourne (RA-To E. NA)	VLC7	11.810
	London (ES-Dictation Speed)	GVX	11.930
		GVU	11.770
		GWT	9.675
		GWG	9.625
		GRI	9.410
		GRJ	7.320
		GSW	7.230
		GWL	7.210
0730	Delhi (AIR)	VUD9	15.290
		VUD3	11.830
		VUD5	9.630
		VUD2	7.290
		VUD8	7.275
		VUB3	9.590
	Bombay (Delhi Relay)		
	Calcutta	VUC3	9.530
	(Delhi Relay)	VUC2	7.210
	Madras (Delhi Relay)	VUM3	7.280
		VUM2	4.920
	Akashvani	VU7MC	6.028
	(AIR Relay)		
	Georgetown	ZFY	5.984A
	(Caribbean News)		
	Cebu	DYH2	6.140
	Toronto	CFRX	6.070
	Manila	DUH4	9.620
		DUH2	6.170
	London (ES)	GVX	11.930
		GVU	11.770
		GRG	11.680
		GWT	9.675
		GWG	9.625
		GRI	9.410
		GRJ	7.320
		GSW	7.230
		GSV	7.210
0750	Borne (To S.E. Asia)	HER6	21.520
		HER5	15.305
		HERS	11.865
0800	London (GOS-To NA)	GSK	26.100
		GVB	21.710
		GSH	21.470
		OSI	15.280
		GSO	15.180
		OSF	15.140
		GWG	15.110
		GVU	11.770
		GSD	11.750
		GVW	11.700
	Halifax	CHNX	6.130
	Sydney	CJCK	6.010
	Toronto	CFRX	6.070
	Melbourne	VLC6	15.320
	(RA-To Pacific)	VLA6	15.200
	Force, Asia	VLC4	11.850
	North Pacific)		
	Melbourne	VLH3	9.580
	(ABC-BBC Relay)		
	Sydney (ABC)	VL12	6.090
	Brisbane	VLC3	9.660
	(ABC)	VLM	4.917.5
	Perth (ABC)	VLWS	9.610
		VLC2	6.130
			4.897J
	(Via Pt. Moresby-ABC)	VLTS	7.280
	Kosta Radio, Sumatra (To S.E. Asia)		11.840
	Los Angeles	KWIX	11.860
	(AFRS)	KCBF	9.700
		KGEI	9.670
		KCBA	6.120
	Toungoo, Burma		7.380A
	Manila	DZH3	11.780
			9.505A
	Colombo (Radio Ceylon-BBC Relay to Far East)		21.620
			17.730
	Jodhpur, Rajputana		3.775
	Melbourne	VLH3	9.580
	(ABC)		
	Brisbane (ABC/VLC3)		9.660
		VLM	4.917.5
	Melbourne	VLC7	11.810
	(RA-To E. NA)		
	New York (VOA)		17.830
			15.350
	Davao	DYB2	4.985A
	Mindanao	ZBW3	9.525 V
	Hong Kong		
	(Delayed BBC Relay, Radio Newsteel)		
	Rangoon (7)		7.170A
	(Force Station)		
	Colon (Delayed HP5K Relay of VOA)		6.005
0820 (NS)	Edmonton	VE9A1	9.540

(Continued on page 100)

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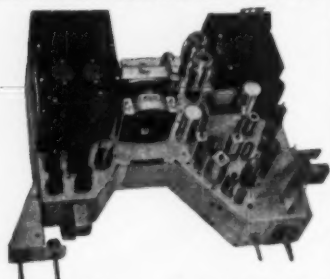
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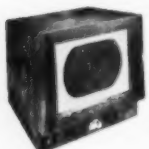
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 - DEFLECTION YOKE
 - YOKE MOUNTING HOOD
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VOLTAGE DOUBLER DELUXE Complies with
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- COMPLETE TV TUBE KIT, inc. CRT (29 tubes) 21.27

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(Continued from page 100)

	Montreal (To Europe)	CKNC	17.820	1418	New York (AFRS-To Europe)	WGEX	3.435
	London	CKCS	15.320			WBOS	15.210
	(To NA)	GST	21.890			WNRX	11.890
	Johannesburg (SABC)	IV	4.800	1430	Leopoldville (To Europe)	WRCA	9.670
	Malindi (SABC Relay)	V	4.373	(NS)		OTC2	9.768 A
	Manila	ZNB	5.900	(NS)	Calgary	CFVP	6.030
	London (GOS-Real News-ree)	DZHS	9.685		Edmonton	VE3AI	9.540
1215		GVS	21.710		Warsaw (Radio Polskie)		6.220
		GVR	21.675		Sofia		7.671 A
		GSH	21.470		Moscow		7.340
		GRJ	17.715				6.090
		GWG	15.110				6.000
		GSN	11.820	(I)	Lake Success (Via VOA)	WOOC	15.130
		GWH	11.800			WNRI	11.770
		VUD5	15.290			WNRA	8.815
	Delhi (AIR)	VDU11	11.850	1440	Rome (To Europe)		11.810
(NS)	Toronto	CFRX	6.070				9.630
1230V (FO)	Khartoum Radio (Omdurman)		9.748	1445	Ankara (To Europe)	TAP	9.495
	Hilversum (To Europe, Africa)	PHI	11.730		Prague (To Europe)	OLR2A	6.010
		POJ	9.590	1500	London (GOS)	GVS	21.710
		POD	6.026			GRA	17.715
1230A	Dublin (Radio Eireann)		17.840			GBI	15.260
1240V (I)	Stockholm	SBT	15.155			GSO	15.180
		SDB2	10.780			GWG	15.110
1245	Prague (To Europe)	OLR3A	9.580			GSN	11.750
	New York (VOA-To Europe)	WNRX	21.730			GRH	9.825
	(Via Munich)	WRCA	15.150			GRY	9.600
		IV	7.280			GSW	9.510
		I	6.170		Georgetown (BBC Relay)	GRW	8.150
	London (ES- Dictation Speed)	GVX	11.930		Port-of-Spain (BBC Relay)	ZFY	5.844 A
		GWO	9.625		Wellington (BBC Relay)	ZL4	15.280
1245V (NS)	Accra	GRJ	7.320			ZL7	6.080
1255 (SO)		ZOY	4.915		London (ES)	GWG	9.525
1300	London (GOS)	VE3AI	9.540			GSF	15.140
		GVS	21.710		London (To NA)	GVW	11.700
		GVR	21.675		Bucharest (To Europe)		11.900
		GRA	17.715				9.253
		GSO	15.180				6.200
		GSF	15.140				5.928
		GWG	15.110				6.010
		GSD	11.750		Sydney	CJCK	11.720
		GSN	11.820	(SO)	Winnipeg	CKRX	6.030
		GWH	11.800	(SO)	Calgary	CFVP	6.030
		GSE	9.510	(NSAT)	Edmonton	VE3AI	9.540
		GRW	6.150		Vancouver	CKFX	6.090
	Malta (FBS-BBC Relay)		4.965		Melbourne (ABC)	VLQ6	15.230
	Nairobi (BBC Relay)	VQO1	4.855 V	(NSAT)		VLH4	11.880
						VLR2	6.190
(SO)	Toronto	CFRX	6.070		Brisbane (ABC)	VLM3	9.690
	Winnipeg	CKRX	11.720			VLQ	4.917 A
(NS)	Vancouver	CKFX	6.090	1509 (FO)	Sydney (ABC)	VLJ2	6.057 A
(NS, Th, Sat)	Edmonton	VE3AI	9.540		Buenos Aires	LRAS	17.720
	Wellington (BBC Relay)	ZL4	15.280	1515	Madrid (RNE-To Europe)	LRAI	9.690
	Salisbury	ZEA	3.658		Tiрана (To Europe)	ZAA	7.847
	(BBC Relay)				Leopoldville (To Europe)	OTC2	9.768 A
1303V	Belize	ZIK2	10.599 A	1525V			
1315	Nairobi (Local News)	VQO1	4.855 V	1530	Tel-Aviv (Kot-Israel)		8.630 A
	Vatican City	HVJ	11.740		Boston (Via Haifa)		8.900
			9.643 V	(WO)			9.130
	Salisbury	ZEA	5.969 A		London (WWBC-To Europe)	WRUX	17.755
1325 (I)	Belize	ZIK2	10.599 A		Melbourne (RA-To Europe)	WRUW	15.350
						VLQ9	11.710
1330	Winnipeg	CKRX	11.720			VL4	11.880
(NS)	Geneva (UN Radio-To Europe)	HBQ	6.672	1545		VLB2	9.650
	London (To NA) GSF		15.140		Brazzaville (To NA)		17.637
1335	Stockholm	SDB2	10.780		(To Africa)		11.972
1337 (NS)	(To Europe)				(To Middle East)		9.987
			11.810			VLQ6	9.440
1345	Rome (To Sou. Afr.)		9.630		Melbourne (ABC)	VLH4	11.880
	Brazzaville (To NA)		17.817			VLR2	6.190
	(To Europe)		11.972		Brisbane (ABC)	VLQ3	9.690
	(To Middle East)	CKX5	9.440			VLM	4.917
	Montreal (CBC-To Europe)	CHOL	15.120	(NS)	Sydney (ABC)	VLJ2	6.090
			11.720		(Via Pt. Moresby-ABC)	VLTS	7.280
1350A	Colombo (Radio Ceylon to AIR)		15.120	1550 (NS)			9.533
				1555	Salzburg (BDN)	VLQ3	9.663
1350	Berne (To Europe)	HER5	11.865	1600		VLM	4.917
		HEU3	9.665		London (ES- France Review)	GRO	6.180
1400	Dharam	EQC	9.660				
	Damascus		11.750	(NSAT, S)	Toronto	CKRX	11.720
			6.000	(NS)	Edmonton	CFRX	6.070
			5.009 A	(NSAT)	Vancouver	VE3AI	9.540
	St. Johns	CBNX	9.333 V		Melbourne (BBC)	VLH4	11.880
	Winnipeg	CKRX	11.720		London (To NA)	VLQ3	11.700
	Edmonton	VED	8.285	1602	Kingston	ZQI	4.950
	(CBC Relay)			1610	Bahae	ZFY	9.384
(SO)	Vancouver	CKFX	6.080	1615V	Budapest		9.834
(FO)	Salzburg (BDN)	JJOY	8.010	1630			6.247
	Athens	WLWS1	21.650		Sofia		7.071
	New York (VOA-To Europe)	WNEI	17.767		Moscow (To Europe)		6.670
		WCBN	15.270				7.340
		WRUS	11.790				6.090
	(Via Munich)	IV	7.250	1645	St. Johns	CBNX	9.370
	(Via BBC, London)	GRF	12.080		Prague (To Europe)	OLR2A	6.010
		GRW	7.070		London (ES)	GRO	6.180
	Wellington (BBC De-)	ZL4	15.280				
		ZL7	6.080				

(Continued on page 104)

OUTSTANDING VALUES NOW AVAILABLE

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Completely Wired

Broadcast and shortwave with phono input. Dimensions: Length 10", Width 6", Overall Height 5 1/4". 4 push-button operation. Tone control, volume control. Tubes: 2—14A7, 14Q7, 7C6, 35Y4, 50A5.

The perfect chassis for amateurs, experimenters, and for a fine performing set.

Complete—less tubes.....\$5.95

Set of tubes for above.....4.00

Alnico V 6" PM for above chassis.....1.59

4-TUBE AMPLIFIER

Uses 2—35L6, 1—35Z5, 1—12SL7 in AC-DC Circuit. Separate tone and volume controls. With universal output transformer.....\$5.29
Less tubes.....2.95

RADIO AND WIRE RECORDER COMBINATION IN CHASSIS FORM

Standard make wire recording mechanism, including phono playback. 8-tube AC operated radio chassis with power supply. Alnico V 6" PM Controls—tone control, volume control, band switch and tuning knob. Completely wired. Chassis includes recording and erasing and playback circuits to make complete wire recorder. Tubes: 12B0, 14Q7, 7C6, 2—50A5, 2—35Y4. Dimensions: 11" long, 6 1/4" wide, 5 1/4" overall depth.

This is just the unit you have been looking for, for your custom-built installation. This chassis is and will give big set performance. The wire recorder renders excellent reproduction, directly from the radio, directly from the phono, or from the mike.

Easy to assemble. Complete instructions supplied with each unit. Price, complete—less tubes.....\$35.00

Set of tubes for above.....5.50

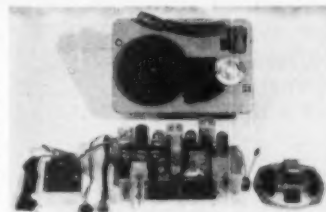
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Above chassis less wire recording mechanism (can be purchased alone).

Price, less tubes, less power transformer.....\$5.95

With power transformer.....8.95

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TUBES

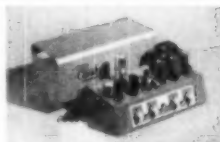
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6H6	1L4
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	6F6G
	6J7
	6K7G
	6V6G
6C4	6X5GT 49c
6SA7GT	7A7
6SH7	12A8GT
6SQ7	12SJ7GT
7B4	14R7
12J5GT	35B5
12SR7	35Z4
76	35Z5
12SH7	77
	5U4G
	12SK7GT
	12SQ7GT
	6AU6
	6BA6
	6SJ7
	50L6

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18-Watt Kit

6 tubes: 1—6SQ7, 1—6SN7, 2—6V6, 1—6SN7, 1—5Y3GT. Mike and phono input. Separate Bass and Treble controls, Heavy steel chassis and cover.



Frequency response 50-17,000 CPS & 1DB. Output impedances 4-8-16-500. Hum level 65DB below rated output. Complete, with tubes.....\$18.95

25-Watt Kit

6 tubes: 2—6SJ7, 2—6L6, 1—6SC7, 1—5Y3. 2 mike, 1 phono input. Separate bass and treble controls.

Output impedance 2-4-8-16-500 ohms. Frequency response 30-17000 CPS & 1DB.

Attractive heavy steel chassis and cover. Push pull phase inverter driver for hum level.

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20 mfd 150V 50 mfd 35V	
20 mfd 50V	19c each
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25x25 mfd—	
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30x30 mfd—	
150V—20 mfd 25V	35c each
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450V common positive	
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Extra Sub-stations \$3.95 each

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1st class, 18 or 20 lb. All SOLID tinned copper double cotton serve, waxed finish.

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18	BROWN	47	5.98	



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(Continued from page 102)

	Melbourne (RA-To Britain, Europe)	VLC9	17.800
	(To E. NA)	VLA6	15.220
	(To Forces- Japan, Asia, N. Pacific)	VLB11	15.180
(NS)	(Via BFOS, Kure)	WLKS	6.105
	Melbourne (ABC)	VLG6	15.230
	Brisbane (ABC)	VLH4	11.880
	Perth (ABC)	VLK3	9.660
		VLW	4.917.5
		VLW5	9.610
		VLX2	6.130
	Sydney (ABC)	VLJ2	4.8971
	(Via Pt. Moreeby-ABC)	VLTS	7.280
(MO)	Colony	HOLA	9.905
1700	Malifax	CHNX	6.130
(SO)	Toronto	CFRX	6.070
	Winnipeg	CKRX	11.720
(NS)	Edmonton	VED41	9.540
	Montreal	CHOL	11.720
	(CBC-To Europe)	CKLO	9.630
(NSAT)	Melbourne (ABC)	VLH4	11.880
	Sydney (ABC)	VLJ2	6.090
1715	Brassaville (To NA)		11.972
	(To Africa)		9.440
	(To Sou. America)		9.440
	(To Africa)		6.024
	St. Johns	CENX	5.970
	Sydney	CHCX	6.010
(WO)	Kingston	ZOI	4.950
(SO)	Georgetown	ZFY	5.984A
	Athens (To NA)		15.345
	New York	WNBI	17.780
	(VOA-To Europe)	WRUL	15.350
		WCBA	15.270
		WRUB	11.750
		WOWW	9.700
	(Via Munich)	IV	7.250
		I	6.170
		III	6.080
	(Via Tangier)	I	7.220
(I)	New York	WOOC	15.130
(I)		WNRI	11.710
(I)		WNRA	11.880
1725V (I)	Kingston	ZOI	4.950
1730	Athens		15.345
(Whdays)			
(NS)	St. Johns	CENX	5.970
	Vancouver	CKFX	6.080
	New York	WGEX	17.765
	(AFRS-To Europe)	WBOS	15.210
		WNRX	11.880
	Moscow	WRCA	9.670
			7.340
			6.090
			5.970A
	London (ES- Press Review)	GRJ	7.320
	Colon	GSA	6.050
	Buenos Aires	HOLA	9.905
1733	(SRI-To Europe)	LRS	11.880
1735	Berne (To NA)	HEI7	15.320
		HER5	11.865
		HER4	9.535
1745	Melbourne (RA-To Sou. America)	VLC9	17.840
	(To Britain, Europe)	VLO6	15.230
	(To E. NA)	VLA6	15.220
	(To Forces- Japan, Asia, N. Pacific)	VLB11	15.180
	(Via BFOS, Kure)	WLKS	6.105
(SATO)	Melbourne (ABC)	VLH4	11.880
	Manila	DZH2	9.640
	London (ES)	GRJ	7.320
		GSA	6.050
1755	Malifax	CHNX	6.130
1800	London (GOS- News)	GWH	11.900
		GSD	11.750
		GSC	9.580
	London (Radio Newsreel-To NA)	GRH	9.825
		GSB	9.510
		GSB	6.110
	Georgetown (BBC Relay)	ZFY	5.984A
	Winnipeg	CKRX	11.720
(SO)	Vancouver	CKFX	6.080
	New York	KCBA	21.740
	(VOA-To Far East)	KCBF	17.770
	(Via Honolulu)	KNBX	15.240
	(Via Manila)	KRHO	17.800
		I	15.250
		III	11.880
(NSAT)	Manila	DUH5	11.840
		DUH4	9.620
		DUH2	6.170
1810A	Manila	DZH3	9.505A
	Madrid	DZH4	6.000
	(RNE-To Na)		9.369V
1815 (I)	Edmonton	VED	8.285

1825A	Moscow (To NA)		9.716
	(To Siberia)		9.630
	(To Siberia)		7.360
	(To Siberia)		7.310
	(Via Komsomolsk)		7.285
	(Via Kiev)		9.723
	(Via Petropavlovsk)		9.670
1830	Buenos Aires	LRS	11.880
	Sydney	CJCK	6.010
(NS)	Toronto	CFRX	6.070
1840	Montreal	CHOL	11.720
	(CBC-To Europe)	CKLO	9.630
1845	Seigon (Radio France Asia)	FZS4	11.780
	Caracas	VYVRU	4.890
	Port-of-Spain	VP4RD	9.525
(M-Th)	Boston	WRUX	17.750
	(WWBC-To Latin America)	WRUL	15.280
1900	Brassaville (To Sou. Afr.)		11.972
	(To Sou. America)		9.973
	(To NA)		9.440
	(To Africa)		6.024
	Prague	OLR4A	11.840
(NS)	Manila	DZH2	9.640
	London (Radio Newsreel)	GRH	9.825
		GSC	9.580
		GSB	9.510
		GRW	6.150
		GSB	6.110
	Stockholm (To NA and Latin Amer.)	SDB2	10.780
		SBO	6.065
	Vancouver	CKFX	6.080
	New York	II	15.330
	(VOA-De-layed Relay to Far East-Via Manila)	III	11.890
			9.530
1925 (NS)	Heiniki	OIX5	17.800
1930	Buenos Aires	LRS	11.880
	(SRI-To Europe)		15.160
	Delhi (AIR-To Far East and S. E. Asia)	VUD1	11.850
1932	Kingston	ZOI	3.480
1945	Paris (RDE- To NA)		9.550
	Georgetown	ZFY	5.984A
	(Argony Newsreel)	VED	8.285
	(CBC Relay)		
1945A	Seigon (Radio France Asia)	FZS4	11.780
2000	London (GOS)	GSD	11.750
		GRH	9.825
		GSC	9.580
		GSB	9.510
		GRW	6.150
		GSB	6.110
	Rome (To NA)		15.120
	Port-of-Spain	VP4RD	9.525
	(BBC Relay)		
	Stockholm	SDB2	10.780
	(To NA and Latin America)	SBO	6.065
(SO)	Vancouver	CKFX	6.080
(I)	Melbourne	VLR2	6.150
	(ABC)		
	New York	WABC	21.570
	(VOA-TO Latin America)	KNBA	21.460
		WCBX	17.830
		WLWK	17.800
		WNBI	17.780
		KWID	17.760
		WRUA	15.350
		WLWR2	15.330
		WCBN	15.270
		WRCA	15.210
		KNBI	15.130
		WRUL	11.790
		KCBR	11.770
		WLWR1	11.710
		WLSW	9.700
		WNRX	9.670
		WGEO	9.530
		WLWO	6.090
2005A	Moscow (To NA)		9.716
	(To Siberia)		9.630
	(To Siberia)		9.600
	(To Siberia)		7.360
	(To Siberia)		7.310
	(Via Komsomolsk)		7.285
	(Via Kiev)		9.723
	(Via Petropavlovsk)		9.670
2022V	Buenos Aires	LRS	11.880
	Rangoon	(SRI-To Europe)	9.543
2025 (NS)	Colon (De-layed Relay to VOA)	HP5K	6.005
2035A	Berne (To NA)	HER5	11.865
		HER4	9.535
		HER3	6.165

(Continued on page 106)

When is a dot not a dot?

Look carefully at the pictures on this page, to see how television creates an image

No. 2 in a series outlining high points in television history

Photos from the historical collection of RCA

• As parlor magicians say: "The hand is quicker than the eye!" But modernize the statement so that it becomes: *Television magic is quicker than the eye*—and that's why you see a photographic image in motion . . . where actually there is only a series of moving dots!

To explain this to laymen, ask them to examine a newspaper picture through a magnifying glass.

Surprisingly, few people know that newspaper pictures are masses of tiny dots "mixed" by the eye to make an image. Even fewer know that the same principle creates a television picture . . . and, when picture after picture comes in rapid succession, the eye sees motion.

Devising a successful way to "scan" an image—to break it into dots which could be transmitted as electrical impulses—was one of television's first basic problems. Most of the methods dreamed up were *mechanical*, since electronics was then a baby science. You may remember some of the crude results transmitted mechanically.

Television as we now know it, brilliant images on home receivers, begins with the invention of the *iconoscope* tube by Dr. V. K. Zworykin of RCA Laboratories. First all-electronic "eye" of the television camera, this amazing tube scans an image—"sees" it even in very dim light—translates it into thousands of electrical impulses which are telecast, received,



Felix the Cat was the "stand-in" when this 60-line image was made *mechanically* in tests at NBC's first experimental television station.



Improved definition is obvious to anyone in this *all-electronic* 120-line image of Felix—transmitted in the early days of NBC television.



By *increasing* the number of scanning lines to 441 lines in each picture frame, RCA scientists gave us a sharper, clearer television image.



And here you see the deep blacks, clear whites, and subtle halftones as transmitted by NBC with our present 525-line scanning system.

and re-created as sharp, clear pictures in black-and-white—on the phosphorescent screens of today's home television receivers.

And, just as the first flickering "30-line" pictures—produced mechanically—eventually became our present sharp 525-line images, so the iconoscope itself was improved until it became today's super-sensitive RCA image orthicon television camera. All-electronic, the image orthicon peers deep into shadows, needs only the light of a candle to see and transmit dramatic action.

But every single television development made by scientists at RCA Laboratories depends, in the end, on a basic physiological fact: When the human eye sees a series of swift-moving dots on a television screen, it automatically "mixes" them into a moving photographic image!



Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION

SELENIUM RECTIFIERS — and — ELECTRONIC COMPONENTS

THREE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-240V AC	Current	Output 0-250V VDC	Price
Type No.			
3R11-1	1 AMP		\$ 22.00
3R11-2	2 AMP		32.00
3R11-4	4 AMP		56.00
3R11-6	6 AMP		81.50
3R11-10	10 AMP		105.00
3R11-15	15 AMP		126.00

CENTER TAPPED RECTIFIERS SINGLE PHASE FULL WAVE

Input 0-180V AC	Current	Output 0-80V VDC	Price
Type No.			
C1-10	10 AMP		56.95
C1-20	20 AMP		96.95
C1-30	30 AMP		149.95
C1-40	40 AMP		179.95
C1-50	50 AMP		209.95

RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and
Type C1 \$6.35 per set
For Types B13 7.76 per set
For Types B15 1.85 per set

SINGLE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-180V AC	Current	Output 0-120V VDC	Price
Type No.			
B1-250	250 MA		\$6.98
B1-1	1 AMP		2.49
B1-1N3	1.5 AMP		2.95
B1-3N3	3.5 AMP		4.50
B1-5	5 AMP		5.95
B1-10	10 AMP		9.95
B1-20	20 AMP		15.95
B1-30	30 AMP		20.95
B1-40	40 AMP		27.95
B1-50	50 AMP		32.95

Input 0-180V AC	Current	Output 0-250V VDC	Price
Type No.			
B2-150	150 MA		\$8.98
B2-250	250 MA		1.25
B2-300	300 MA		1.50
B2-3N3	3.5 AMP		6.95
B2-5	5 AMP		9.95
B2-10	10 AMP		15.95
B2-20	20 AMP		27.95
B2-30	30 AMP		36.95
B2-40	40 AMP		44.95

Input 0-115V AC	Current	Output 0-80V VDC	Price
Type No.			
B6-250	250 MA		\$2.95
B6-600	600 MA		5.95
B6-750	750 MA		6.95
B6-1N3	1.5 AMP		10.95
B6-3N3	3.5 AMP		18.95
B6-5	5 AMP		24.95
B6-10	10 AMP		36.95
B6-15	15 AMP		54.95

CUSTOM DC POWER SUPPLIES

Build to your specifications
We will be pleased to quote on your requirements.
Kindly send for our specification form.

RECTIFIER CAPACITORS

Type	Value	Voltage	Price
CP-14	3000 MF	125VDC	\$1.60
CP-15	6000 MF	125VDC	2.50
CP-1	1000 MF	150VDC	.90
CP-2	2000 MF	150VDC	1.60
CP-20	2500 MF	150VDC	1.55
CP-3	1000 MF	250VDC	1.25
CP-4	2500 MF	250VDC	1.45
CP-5	5000 MF	30VDC	2.49
CP-6	4000 MF	30VDC	1.25
CP-7	3000 MF	35VDC	1.35
CP-8	100 MF	50VDC	.80
CP-9	500 MF	50VDC	1.95
CP-10	2000 MF	50VDC	1.25
CP-21	1200 MF	90VDC	2.25
CP-9	200 MF	150VDC	1.60
CP-10	500 MF	200VDC	1.25
CP-12	120 MF	350VDC	2.49

Mounting clamps for above capacitors: 15c ea.

RECTIFIER TRANSFORMERS

All Primaries 115V AC 50-60 Cycles				
Type No.	Volts	Amps	Shpg. Wt.	Price
NF15-12	15	12	7 lbs.	\$ 8.95
TXF16-2	36	2	6 lbs.	3.95
TXF16-3	36	3	6 lbs.	4.95
TXF16-10	36	10	12 lbs.	7.95
TXF16-15	36	15	20 lbs.	11.95
TXF16-20	36	20	30 lbs.	17.95
NFC18-14	18VCT	14	10 lbs.	8.95

All TXF Types are Tapped to Deliver 32, 34, 36 Volts, N.F.C. Type is Tapped to Deliver 16, 17, 18 Volts Center Tapped.

RECTIFIER CHOKES

Type No.	Hr.	Amps	Dc Res.	Price
RV1	.02	5	20	\$3.25
RV1A	.028	5	20	5.95
RV10	.02	10	30	9.95
RV10A	.014	10	60	7.95
RV15	.015	15	20	13.95
RV20A	.007	20	62	12.95

Type "A" low resistance chokes are specially suited to circuits requiring excellent voltage regulation.

ADDITIONAL SELENIUM RECTIFIER TYPES AND GENERAL INFORMATION MAY BE FOUND IN OUR CATALOG No. 719



VACUUM CAPACITORS

Standard Brands

12 Mfd.	50 V.	\$4.95
20 Mfd.	50 V.	4.95
30 Mfd.	50 V.	5.95

Overall length 6", diameter 2 1/2", terminal diameter 1/2", dips wt. 2 lbs.

EDISON THERMO TIME DELAY RELAY

Heater voltage 115 V. Norm. open 30°FT contacts, 15-30 sec. delay. Contact rating 115 V. 3A., 440 V. 2A., 500, 3/4"x1 1/2" diam. standard 4-prong tube base. Ea. **\$9.8c**

OIL CONDENSERS

5 Mfd. 400VDC. Telephone Type	\$9.20
2X 1 Mfd. 600VDC. Bathbath	.39
6 Mfd. 600VDC. w. metal clamp	.79
8 Mfd. 600V AC 2000VDC w. BRKs	3.50
15-15 Mfd. 800VDC. Voltage Doubler Type 26F381 w. leads	3.95

KLIXON 40 SECOND DELAY SWITCH

Heater operates on 115 VAC or DC. Contacts R/W1—one pair rated at 50 A., 115 V. or 20 A., 220 V. Auxiliary contacts for lighter loads. Ea. **\$2.49**

PILOT LIGHT ASSEMBLIES

Overall type, panel mounting, either power supply, heated, inc. outside DIMENSIONS: 1" Bakelite and aluminum construction. Bulb replaceable from front panel. For single contact bayonet bulb, up to 7 1/2" size. Dimensions: 2 1/2" overall length, 1/2" diameter, 3/4" panel mount hole. 1M4. DELIVERABLE. 500 to carton, needed. \$50.00 per carton. Prices on larger quantities on request.

SILVER CERAMIC TRIMMERS

820-Z 5-20 Mfd. Zero Temp.	.24c
822-N 5-20 Mfd. Neg. 300	.14c
822-AZ 4.5-25 Mfd. Zero Temp.	.24c
823-AN 20-125 Mfd. Neg. 600	.33c

ATTENTION !!!

Bulletin No. 713, listing various government and commercial surplus items, is now available upon request.

DC POWER SUPPLY

Limited quantity—Gov't Surplus

Ready to operate Full-wave bridge, copper-oxide rectifier, heavy-duty multi-tapped transformer. Input: 85, 95, 105, 115 VAC. 50, 60 cps. Output: 2.5-24.28, 32.30 VDC at 7 amps. unregulated. For wall or bench mounting. Overall dimensions 9"x6 1/2"x3 1/2" high. Shpg. wt. 30 lbs. like new. Tested and guaranteed. **\$36.00**
Filter Kit 2% ripple **\$6.65**

DIEHL MOTOR

Fan duty, brushes in, duration type inc. TV interference. For 115 VAC, 60 cycles, 40 watts, 1800 RPM shaft 1/4" diam. 1" long. Non-leak, ball-bearing, heavy cast construction. **\$4.50**

RECTIFIER KIT No. 612-10

6 and 12 VDC at 10 Amps. This unit will deliver unfiltered direct current for operation of diodes, dynamos, seleniums, electroplating, battery charging and similar equipment. The two output voltages can be used simultaneously, and can be varied above and below their nominal ratings. Complete with schematic diagram and instructions. Shpg. wt., 12 lbs. **\$15.95**

FILTER KITS FOR No. 612-10

1 section choke input, 10% ripple	\$9.64
2 section choke input, 2% ripple	19.28

D-C PANEL METERS

Attractive, rugged, and reasonably priced. Moving vane selected type with accuracy within 2% 0-6 Amperes D-C. Amp range \$2.49 each 0-15 Volts D-C.

Minimum order \$3.00. No C.O.D.'s. Add 10% for Prepaid Parcel Post and Handling. Terms: Net 10 days in the presence of approved credit.

All prices subject to change without notice.

Prices and delivery F.O.B. our NYC Warehouse.

All merchandise subject to prior sale.

WESTERN ELECTRIC BLOWER

KS8884—Brand New—Heavy-duty Stromberg-type blower capacitor start, 1/40 H.P., 3400 RPM, 115 VAC, 60 cps. Displaces 84 CFM. Extremely quiet operation. Opening 2 1/2" overall size 7 1/2" long, 6" diam. Moisture and fungus resistant. With capacitor. Shpg. wt. 1 1/2 lbs. Quantity limited. **\$13.95**

DIEHL BLOWER

Sirocco type, displaces 100 CFM, 115 VAC, 60 cps. Moisture and fungus resistant. Flange diameter 4". Overall size 7 1/2" x 6 1/2" x 1 1/2". Removed from equipment. Tested and guaranteed. **\$9.95**
Adjustable right angle aluminum extension tube to fit flange **98c**

WESTINGHOUSE AIRCRAFT MOTOR

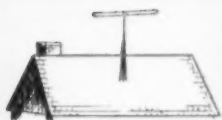
Brand new, 25 VDC or AC, 250 RPM, reversible on both, 1/30 H.P., 4000 RPM continuous duty. Length of leads 18". Dimensions: 3 1/2" x 2 1/2" x 1 1/2". diam. by 1/2" long. 1/2" shaft. Price **\$2.95**
Reversing switch with 27c position. Each

OPAD-GREEN ★ COMPANY ★

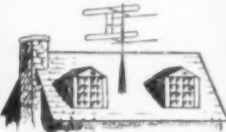
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PENN Thriftower

Costs less than 75c...
Weighs less than 2 lbs...
...per Foot!



SELL THE BULK! Low price sells lower and middle income groups.



SELL THE CREAM! Improved reception sells upper income brackets.

Right along, tripod-type towers of sectional construction have been the choice of the "cream" of television's market. Through elevating antennae, such towers extend fringe area and improve reception. Now — Penn offers a tripod tower priced within reach of the ever-expanding "bulk" market. Be among the first to profit — write today for details about the still-available Penn dealer propositions.

Prices to Retailers

THRIFTOWER "30" — Composed of 20' of tower welded as a single unit with 10' 1" O.D. adjustable pole, total approximately 30' overall \$24.75
THRIFTOWER "40" — Composed of 20' of tower, same as Thriftower 30, with 20' 1" O.D. doubly reinforced adjustable pole giving a total overall extended height of approximately 40' \$29.75

PENN Teletower
Penn Boiler & Burner
Mfg. Corp.
Makers of Penn
Packaged Heat
ESTABLISHED SINCE 1932
LANCASTER, PA.

Antenna Laboratory

(Continued from page 34)

about 8000 mc. and 40 to 50 mw. for frequencies above this. Sensitivity of the simple receivers used in the models is quite low and, upon numerous occasions, the model simply cannot be placed at the required distance and still secure sufficient signal to record a pattern. The model tower must then be moved into the so-called "near zone" region and many hours spent in calculations and educated guesses in order to replot the pattern to some degree of accuracy. The uninitiated invariably suggest going to higher powered transmitters such as radar pulsed units. When such suggestor, however, ponders over the problem of building or purchasing the number of high power, room-size radars needed to cover the frequencies called for, he soon realizes that a fairly large warehouse would be needed to mount them for use.

Rejoining the antenna engineer it is found that his new antenna has successfully completed its preliminary radiation pattern tests. While mildly jubilant he must still subject his creation to an investigation to determine its response to cross-polarized signals. Also he must investigate what effect additional structures, such as wing mounted rockets or bombs, have on its pattern. The worried frown will remain on his brow for some time to come as he follows the antenna through the intricate maze of production decisions, cost analysis, and lastly the flight test which places the final stamp of approval on his work.

While emphasis has been placed on the aircraft antenna because of its present importance, it should be made clear that the laboratories of such institutions as Ohio State University are carrying on programs of investigation into many other aspects of the antenna problem. For example, in the study of land-based radio stations scientists must content themselves not only with dimensional perfection with regard to towers and buildings.

Fig. 11. View of "feed" end of large horn type antenna. Coaxial cable shown supplies v.h.f. energy to probe "feed" for the large horn type "illuminating" antenna. Microwatts are precious, and technician carefully adjusts the matching stub for the maximum obtainable signal.



2 BIG SPECIALS

Plus 100's of other items too numerous to mention.

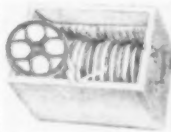
PORTABLE PUBLIC ADDRESS SYSTEM

Model CS-31-C made by Silman Mfg. Co. for the U.S. Army. Ideal for camps, boat races, ski races, loading platforms, etc. etc. It's a battery operated amplifier with 2 tubes, 1H4-LB; hand microphone and trigger type switch microphone and loud speaker; 4 1/2' roll-up metal tripod; batteries and carrying case. Brand New. Shipping Weight 25 lbs. While they last.



\$39.95

AT LAST



We have announced VIDEO PRACTICE TAPE, which was used for video practice work by the Signal Corps from June 15, 1945 on. It's only on 16MM metal reels in Geac's standard cloth case, to be used with Microfilm Keyers, Tone Keyers or any other machine and some of the best tape. Special price **\$9.95**

Prompt Delivery—25% deposit required on C.O.D. order. Shipped F.O.B. New York. Write Dept. RN-3

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RADIO & TELEVISION NEWS

but must also actually design the soil of these scale models to have proper conductivity at the higher model frequencies in order that it simulate the soil found in the region under study. The "guess and by-gosh" methods of the past in making costly antenna installations are slowly giving way to exact knowledge.

Last but by no means least, Naval research centers are engaged in measuring the radiation patterns of antennas mounted within the complex maze produced by a ship's masts, cables, and other marine structure. As might be expected, Naval antenna designers must take the sea into account when making their scaled-down ships for range tests. To an electromagnetic wave a ship resting upon the sea appears to have an exact mirror image directly beneath it. This can be duplicated on the Naval antenna model range by cutting a ship model off at its water line and resting it upon a large sheet of metal. In lieu of this, two ship models are constructed, sawed off at the water line, and one fastened upside down to the waterline of the other. The technique of making the actual radiation pattern measurements is identical to that described for aircraft.

ONE MA. METER

By MILTON KALSHIAN

A 1 ma. meter is a very handy item, but unfortunately it is rather expensive and therefore most of us don't have as many of them as we could conceivably use.

Fortunately, most of the units that utilize the 1 ma. meter are rarely in operation at the same time. For example, the v.o.m., the f.s. meter, grid dip meter, modulation monitor, and the absorption frequency meter are all popular pieces of ham equipment which generally incorporate a 1 ma. meter, but seldom are these units used simultaneously.

This being the case, it is a very simple matter to use one meter in all these instruments. The answer to the problem is to make the meter "plug in." This is easily done by purchasing banana plugs that are tapped to take a 10-32 machine screw. Most manufacturers have standardized on this size and thread for the terminal posts on the meters. Next screw these plugs onto the meter terminal posts.

The equipment with which the meter is to be used should have a bracket installed several inches behind the front panel, the exact dimensions depending on the size of the meter used. The bracket should have two insulated banana jacks to match the banana plugs on the meter when the meter body is passed through the front panel meter cutout normally provided for mounting the meter. The mounting bracket should be placed behind the front panel in such a way that when the meter is plugged in the mounting flange of the meter case will be flush with the front panel.

The banana plugs provide enough tension to hold the meter securely in place, therefore mounting screws are unnecessary. Thus all one has to do is unplug the meter from one piece of equipment and plug it into another.

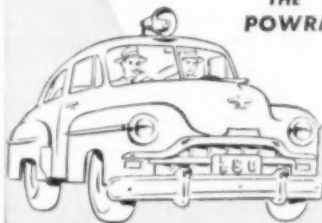
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ALSO FOR MOBILE AND
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- AMPLIFIES WITHOUT VACUUM TUBES
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- INSTANTANEOUS OPERATION
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The new UNIVERSITY POWRMIKE opens a new field for sound distribution. Low in cost, requiring no amplifier, completely portable, POWRMIKE can be used in thousands of applications where power supply or high cost rule out sound amplification. POWRMIKE has a maximum output of 1.5 watts, reproduces speech with excellent fidelity and is instantaneously operated by handy press-to-talk switch. Additional speakers may be added for broader coverage and special switching arrangements.

POWRMIKE is the perfect answer for voice amplification in stores, carnivals, rallies, waiting rooms, auctions, outdoor markets, sight seeing buses and boats, school group activities, police and fire department work, etc. Get the complete story on sensational POWRMIKE, today.

MODEL PC-66 — For applications requiring portability. Includes: POWRMIKE microphone wired to loudspeaker, "Hot-Shot" type battery mounting bracket with volume control, and automobile current adapter.

MODEL PC-60 — For mobile operation and special installations. POWRMIKE microphone, loudspeaker, and automobile cigarette lighter adapter, supplied unwired.

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100,000	1%		.55
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700,000	1%	125,000	3%
600,000	1%	109,000	1%
Following sizes are \$0.25 each:			
95,000	1%	or better—others 2%:	
20,000	7,500	1,400	70
92,000	17,000	5,000	1,200
84,000	15,000	4,500	1,000
82,000	12,000	4,300	750
80,000	11,000	4,000	140
66,000	10,000	2,200	130
46,000	8,000	1,500	125
33,000			

Following class are \$0.15 each; \$12.50 100 odd types are 1% or better, round numbers are 3% or better:

.399 meg.	50,000	2,230	110	35
.268 meg.	26,000	1,123	70	30
109,000	22,000	280	50	6
84,500	17,300	235	40	4
Following sizes are \$0.10 each; \$8.50 100 odd types are 1% or better:				
53.96	13.52	4.3	2.14	.25
53.32	13.33	3.94	1.563	
33.22	10.2	3.8	.29	
23.29	5.1	2.56	.258	

New Surplus Relays

Following Types are \$.55 each

Any combination of 50 for \$25.00

- #1026 ISOLANTITE RELAY D.P.D.T. Heavy Contacts. 12 coils, 12 coils, D.C. Excellent for antenna switcher.
- #1028 RIM RELAY S.P.S.T. Heavy Contacts. Air-craft starter. 12 coils, 12 coils, D.C.
- #1031 GM RELAY D.P.D.T. plus S.P.S.T. Coil 20 ohms, 4 volts D.C.
- #1035 ALLED control #1008. 1 Make 1 Break. Heavy Contacts. 12 coils, 2 to 10 unswitched wires.
- #1036 MINUTEMAN RELAY RIM. 2550. S.P.D.T. Plus S.P.S.T. Normally open. Coil 250 ohms, 12 to 24 volts, D.C.
- #1041 412 DISK ANTENNA SWITCHOVER RELAY D.P.D.T. Ceramic insulation. Coil 24 volts, 4 volts D.C.

Following types are \$.85 each

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- #1021 ALLED BOUNDER Two circuit. Heavy duty contacts. 24 coils, D.C., 250 ohms, thermal dimension, 100% switch.
- #1022 ALLED CONTROL #1008D. 1 Make 1 Break. Heavy Contacts. 12 coils, 2 to 10 unswitched wires.
- #1023 ALLED CONTROL #1008V. 12 coils, 2 to 10 unswitched wires.
- #1024 ALLED CONTROL #1008V. 12 coils, 2 to 10 unswitched wires.
- #1025 ALLED #1008V. Miniature relay. S.P.D.T. operation from 12 volts D.C. Coil 150 ohms.
- #1026 RIM RELAY RELAY. Shaft rotator standard relay water switch. Coil 60 ohms tapped at 1 ohm.
- #1041 RIM 4 VOLT RELAY-DEAD CONTACTS. D.P.D.T. Coil 18 ohms.
- #1042 TELEPHONE TYPE RELAY. S.P.D.T. plus D.P.T. Normally open. Coil 100 ohms, 10-12 volts, D.C.
- #1043 SENSITIVE MINUTEMAN RELAY. Operation on 2 volts, D.C. Resistance 5.0 ohms. Heavy Type 221. Coil #2780 Single screw mounting.

SPECIAL RELAYS

- #1022 Sensitive Miniature Relay. 12 coils, D.C. relay. Contacts S.P.D.T. plus S.P.S.T. No coil resistance limit shown. Has built-in thermostat switch with bimetallic element and limit chain for timing. Also used for auto overload control or time delay action. Price \$1.45
- #1031 CLARE RELAY. Telephoto Type. Heavy contacts. D.P.D.T. Coil 100 ohms, 110 volts, D.C. Available with or without screw metal plug in base. Price \$5.95
- #1035 110 VOLT D.C. RELAY. Rack type 2025. 12 coils, 110 volts, D.C. Heavy contacts. D.P.D.T. plus S.P.S.T. (plus locking contacts). Mounted on screw base with screw and nut for mounting. Price \$1.45

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- #1025 100 VACUUM RELAY. Heavy contacts with break over valve and open 10 ampere. Standard resistance. 200 ohms, 24 volts, D.C. Excellent for R.F. antenna relay. Price \$5.95

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Modern TV Receivers

(Continued from page 52)

wave which is locked to the station's horizontal line frequency. The negative peaks of this sine wave drive the grid of V_2 to cut-off, causing only a half-wave to appear in the plate circuit. This wave is differentiated by C_1 and L_2 , producing alternate positive and negative pulses which are applied to the grid of the blocking oscillator. These positive pulses trigger the blocking oscillator, keeping it in synchronism with the incoming pulses. The saw-tooth deflection waveform is then developed in the plate circuit of the blocking oscillator by components C_2 and R_2 .

The locked-in oscillator for television synchronization possesses one marked advantage over the a.f.c. systems previously discussed in that the synchronization actually becomes more stable as the signal becomes weaker. The stability of this circuit lies chiefly in the "Q" of the resonant circuit (R_2 , L_2 , C_2 and C_1) of the locked-in oscillator. Now, every tuning circuit functions as a bandpass filter, accepting a small range of frequencies and rejecting all other frequencies. The higher the "Q" of the tuned circuit, the greater its power of discrimination—in this instance, against noise pulses other than the proper horizontal synchronizing pulses.

A logical assumption, then, would be to make the "Q" of the circuits as high as possible. There is one difficulty, however. The sync pulses transmitted by the broadcast station are not absolutely fixed in frequency but possess a certain frequency variation. If the resonant circuit selectivity is made too high, two things will happen. First, if the sync pulses should drift in frequency too far from that of the resonant circuit, sync control will be lost. Second, even if sync control is maintained, slight frequency variations in the sync pulses will cause a phase shift in the generated sine wave. Since the triggering pulses are derived from the generated sine waves, they, too, will shift, producing a horizontal shifting of the television picture.

As a compromise, the "Q" of the resonant circuit is kept somewhere be-

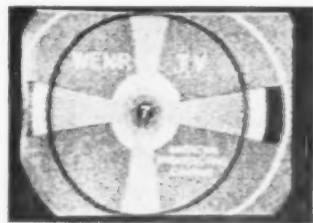


Fig. 7. Appearance of a picture under weak signal conditions in a set not possessing an automatic frequency control.

tween 10 and 30, depending upon the value of R_2 in Fig. 6. Since the diode, V_1 , shunts R_2 , it, too, will affect the "Q" of the resonant tuning circuit. When the signal received is strong, the current through the diode is high, the diode resistance is low and the "Q" of the locked-in tank circuit is lowered. On the other hand, when the signal strength is low, the current passing through the diode is low and the diode plate resistance is high. This reduces the diode shunting effect, enabling the "Q" of the tuned circuit to be higher.

When the circuit was first designed, R_2 was given a value of 470 ohms. This value was satisfactory whenever the station sync pulse frequency was maintained within the limits established by the FCC. In some areas, however, it was soon discovered that the station was not adhering to FCC regulations and a higher valued resistor (lowering the "Q" of the circuit) was required. Hence, the indicated value of 1500 ohms in Fig. 6.

There are three adjustments in this circuit: A lock-in control and two frequency controls. The iron core in L_2 can be considered as a rough tuning adjustment whereas R_2 is a fine tuning control. This is the horizontal hold control positioned on the front panel. The third control, labeled lock-in control, is a screwdriver adjustment on the rear of the chassis. It governs the lock-in range of the horizontal sync system and requires adjustment only if the picture does not remain locked in over the entire range of the horizontal hold control. With normal contrast and the hold control in mid-position, the lock-in coil at the rear of the chassis should be adjusted until the

Fig. 6. A locked-in oscillator circuit for television synchronization.

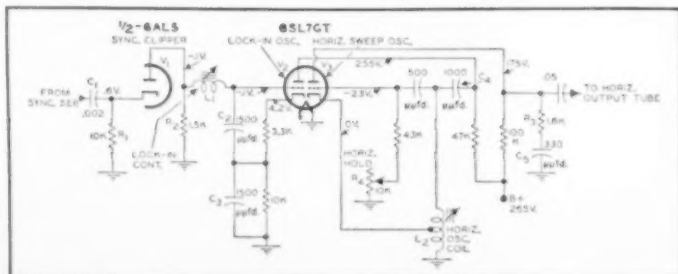




Fig. 8. Same picture as Fig. 7 only in a set using a locked-in oscillator circuit.

picture remains in sync throughout the entire range of the horizontal hold control. However, it is permissible for tearing of the picture to occur at the extreme end of the hold control.

Figs. 7 and 8 show the effect of the locked-in oscillator on a picture being received under weak signal conditions. Fig. 7 was obtained when the set used the incoming sync pulses to trigger the horizontal sweep oscillator directly. Note the improvement in Fig. 8 when the locked-in oscillator was employed. Sync jitter is gone and the readability of the small letters has improved markedly.

The author is indebted to Kurt Schlesinger, who developed this circuit, for an interesting discussion on the properties of this oscillator under various conditions. Figs. 7 and 8 were also furnished by Mr. Schlesinger and are being used with his permission.

(To be continued)

Electronic Organ

(Continued from page 43)

ferent tubes and parts and circuits. Probably I have given the reader some ideas which he can combine with some of his own to produce something very different and better. I know I shall rebuild this entirely and immediately. I have drawn the plans of a complete organ that can be used independently of the piano. One on which you may play chords or any piece of music, using all the fingers of both hands. That will make a very expensive and elaborate instrument. I plan on cutting the cost a little by using surplus parts on hand. That is the way of the ham—always trying to make everything better. Very often we succeed by making it worse!

The best transformer to use is the one from the BC-456. Terminal No. 2 goes to grid. No. 1 to ground. No. 3 to plate. and No. 4 to "B plus."

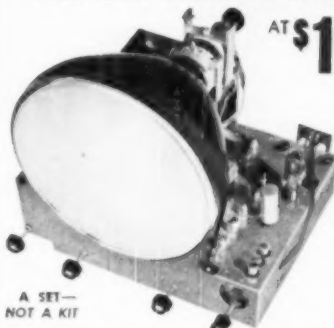
The small single plate to push-pull grid transformer made by Stancor, as their type A-53C, will work just as well but is more expensive than the surplus units.

If the Stancor unit is used, the green lead goes to grid, the yellow to ground, the red to plate, and the blue to "B plus." This transformer is light and small and will make a small and neat assembly, reducing the over-all space required.

-30-

March, 1950

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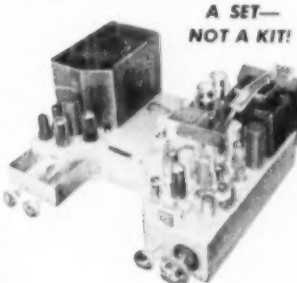
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Recording Amplifier

(Continued from page 63)

The three-inch speed is capable of handling a frequency range of up to four thousand cycles, approximately the equivalent of a small table model radio, and is useful for dictation or recording of non-musical radio programs. The seven-inch speed provides reproduction to about eight thousand c.p.s. and is useful for general purpose, medium quality recording, such as musical programs, dance bands, voice, and copying prized disc recordings to tape, as well as other applications. The fifteen-inch speed is useful for full-range reproduction up to 15 kc. and may be used in radio broadcast or master recording for copying onto 7" speed tape or disc.

A number of interesting opportunities are open to the constructor who builds his own system. One of these is the use of simultaneous, dual-track recording, either for binaural reproduction or with a second track for control purposes, such as volume expansion. A number of half-track heads are now on the market and may be adapted for this purpose by using two heads in conjunction with a permanent magnet erase system.

Another application is to use the playback mechanism as a signal generator by running a small, endless belt of tape through the machine. This has the advantage that a number of loops with sine or complex waves may be kept for convenient use. Likewise, a simple sweep frequency audio signal generator might be made in this fashion, the rate of sweep being determined by the tape speed and length of the loop.

For advertising, or other purposes, it may be possible to run a loop of tape the length of the room thus continually reproducing a message of a minute or two duration which could be turned on or off by some external mechanism, such as a photocell or capacity relay. A similar arrangement is to set the machine to "recording" and place a separate pickup head and amplifier some distance down the tape to allow the person talking to hear his own voice, as if an echo. It is possible that the same principle might be applied to difficult public address locations, either to reduce feedback or to synchronize widely separated loudspeakers acoustically.

For the professional or semi-professional recording engineer, a good tape recorder capable of fifteen-inch speed should provide a convenient means for making high quality recordings of bands, orchestras, vocal groups, and other events in which it would be inconvenient for the performing group to use a regular recording studio. In cases where only a limited number of individuals desire copies of a particular piece of music, the master tape may be re-

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RADIO & TELEVISION NEWS

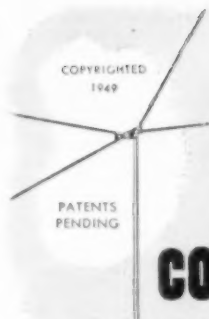
recorded as often as desired on conventional discs or seven-inch tape. The ability to obtain excellent results with a comparatively light weight tape recorder seems to indicate a much wider market for recordings among individual members of dance bands, high school and college groups, and other musical associations.

From a personal standpoint, tape is even cheaper than the new LP records if twin-track operation is used at seven-and-one-half inches per second. The long playing feature is retained and the additional advantages of low noise level, excellent transient response, and freedom from dust, needle wear, and turntable rumble, and eventual reuse, if desired, are included. In building up a tape library a number of factors may be considered. Reels which are to be kept should be clearly marked to avoid accidental erasure, while separate selections on the reel may be easily identified by means of colored crayon marks on the back of the tape. Reels should be stored where they will not be subjected to high temperatures.

Program material may be obtained by re-recording rare discs from your own collection or that of friends, or by recording radio, particularly live FM, broadcasts. First hand recordings of community musicians and concerts often provide an excellent source of material and in some instances are definitely preferred to conventional recordings of well-known artists. In addition, at least one company, the *Amplifier Corp. of America*, has released a catalogue of various selections on tape, with the likelihood that others may follow suit.

In conclusion, a few notes on microphone technique might be advisable. Due to the fact that there is no physical inertia in the tape recording mechanism and no adjacent grooves to overcut, it is possible to record percussion instruments with excellent brilliance and clarity. As a result it is not necessary to place the microphone away from these instruments and the experimenter may indulge his taste for good, heavy bass drum or crashing cymbals. In order to provide the excellent detail that a tape system is capable of recording, a crystal microphone is specifically recommended as an excellent means of picking up transients and low level sounds, and, with a good operating recording and playback system, provides a smooth, clear, approximation of the original sound.

However, as listening tastes may vary greatly with the individual, some constructors may prefer the less brilliant reproduction of a dynamic microphone. Similarly, no specific equalization circuits were included in the amplifier schematic, other than a simple tone control, as proper equalization will depend upon the associated equipment used as well as the constructors' tastes.



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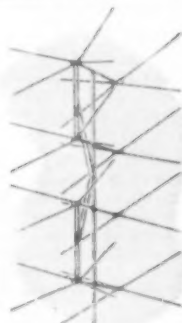
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Mini-Rack Transmitter

(Continued from page 47)

is no necessity for extreme isolation between the input and output circuits. For this reason, a less expensive 6V6GT may be substituted in the buffer stage without appreciable loss in efficiency. With either tube, plenty of output is obtained to drive the final amplifier for plate modulated phone operation on ten meters.

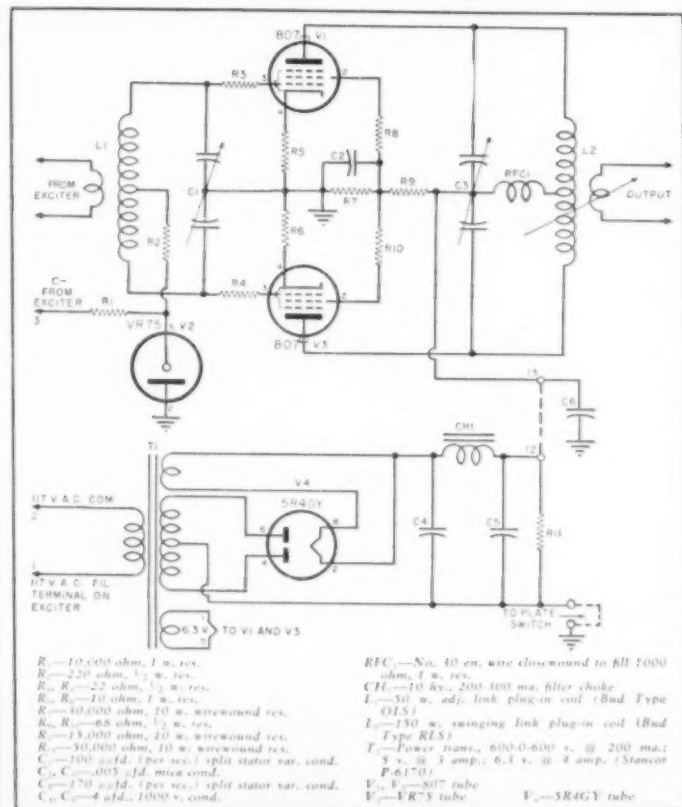
The construction of the push-pull 807 stage is evident from the photographs. Only a single baffle shield is used between the grid and plate circuits, but the axis of the grid coil is at right angles to the plate coil axis to minimize electromagnetic coupling between them.

Either a VR75 or a VR90 may be used for the bias voltage regulator although a VR90 adheres a little closer to the published recommended operating condition for phone. At either bias voltage the key-up plate current is zero. Following standard practice for 807's, parasitic suppressing resistors are used in grid, screen, and cathode leads.

It is sometimes found that it is impossible to load an amplifier up to rated power input with commercial "swinging link" coils, even with the link fully meshed with the tank coil. This condition indicates that the loaded tank circuit "Q" is too low. Since the loaded tank "Q" is directly proportional to tuning capacity, the remedy is a decrease in the L/C ratio. It was found necessary to short out two turns on each end of the Bud 40 meter plate coil to secure proper loading. A "Q"-meter test of the coil showed that the unloaded "Q" was only slightly reduced by the shorted turns so the tank efficiency is reduced by this measure by only a negligible amount.

The power supply for the final amplifier is inexpensive and constructed using a widely available power transformer. A single 5R4GY rectifier will deliver the 200 ma. output without difficulty. Mercury vapor rectifiers have been avoided because of the "hash" they usually radiate to the receiver. With a somewhat larger-than-necessary (300 ma.) filter choke which happened to be available, the power supply output voltage is 600 volts at a load of 200 ma. Switches were omitted from the power supply since a sepa-

Schematic diagram of the 100 watt final amplifier unit.



117

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Equipped with 1/2" Jacobs Geared Chuck

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SC8610 portable 8, 12 and 24V crystal controlled transmitter/receiver with built-in loudspeaker on receiver, complete **\$59.95**

Total Due \$100.00

Many adjustments on radio and TV sets require that the chassis be grounded by a standard procedure. Using a new transformer this can be done as routine procedure on every set on the test bench, ending the hazard of shock. Constructed as auto transformers these isolation transformers can also be used to change 110V to 220V or the reverse. We do not believe that 100 watt 115V isolation transformers have ever before been offered at less than double our price of \$2.95.

9. AUDIO AMPLIFIER-Brand new push-pull output triode amplifiers having 2 of the valuable and scarce output type audio transformers that sell for over \$10.00 apiece. Neat aluminum case, fully enclosed (largest dimension 6 inches). Perfect for intercom systems, phone amplifiers, microphone, or signal tracer amplifier.

"DRILLMASTER"

low-priced electric drill, ideal for home use. Complete with sander, buffers, grinding wheels, etc. This is bankrupt stock and only a few are available. A sensational bargain at \$29.95. Satisfaction guaranteed or money refunded if returned paid within 2



UFRAD SECTIONAL TOWER

police, or amateur transmitters, and in addition the tower will

Genuine Labco-
tory-type precision
signal generator.
Manufactured and
sold for \$65.00 each
in large quantities
during the war in
Northwestern En-
gineering Corp.,
one of the top
manufacturers of

•

High quality standard production line R&D in kit form with complete instru-

\$12.10 \$25.00.



(All three items below)
ALUMINUM GEAR BOX 174447 1144

SIGNAL CORP INTER-CONNECTOR RELAY BOX 2222

CONNECTOR RELAY BOX 736A
This valuable unit, made by Bell, and more familiarly known by the U. S.

only \$1.99

4 x 3 x 2 containing 2 perforations, triple pole switch, 4 screws.

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eliminated a few from the list. The final selection was made by our company.

W 24

Complete with 100 lb. gauge 4 finger tip adjustment allows setting of output pressure.

disturbance, insects etc., resulting in bark loss with natural gap, hollow trees, etc. (Fig. 5.1.4.5). Another common disease of

CERAMIC INSULATED VARIABLE AIR CONDENSERS

50 mmf	\$ 45	10 far	\$ 3.70	100 far	\$ 3.10
75 mmf	\$ 50	10 far	\$ 4.40	100 far	\$ 3.8
100 mmf	\$ 55	10 far	\$ 5.10	100 far	\$ 4.20

100 mmf per section \$5.00 10 for \$50.00

2 gang 140 mmf—\$1.00, 10 for \$12.50,
100 for \$100

IN STOCK.

BUFFALO RADIO SUPP

\$2.00 Manufacturers and prices on larger OVER 250,000 V.I. IN STOCK.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. **RN-3**, BUFFALO 3, N.Y.

1196

TRANSVISION

A MESSAGE TO

Service-Dealers: WORRIED ABOUT COMPETITION? Become the TV SALES and SERVICE CENTER

IN YOUR COMMUNITY

- Beat competition at a profit.
- Stop being undersold — by anybody!

Here's a real opportunity to MAKE MONEY in Television. If you can qualify, you can become the Transvision Television Center in your community — and BUY TV and RADIO PARTS AT JOBBER PRICES. Practically no investment required. This offer is open only to service-dealers in territories where we do not have an authorized distributor. CONTACT US today!

Now... 16" WIRED TV CHASSIS

Completely wired and aligned by TRANSVISION. Specify: MODEL W16RS TV CHASSIS. List price, less C.R. Tube \$139

Also available as a KIT which can be completed in ONE DAY. Specify: Model W16RS TV KIT. List price, less C.R. Tube \$119

FILL OUT AND MAIL THIS
COUPON NOW!

TRANSVISION, INC.
NEW ROCHELLE, N. Y.

Please ship THROUGH YOUR NEAREST
LOCAL OUTLET: RN 3-50

I am enclosing 10% DEPOSIT in the
amount of \$ _____ balance C.O.D.
() Send details of TV CENTER PLAN.

Name _____
(please print)

Address _____

City & State _____

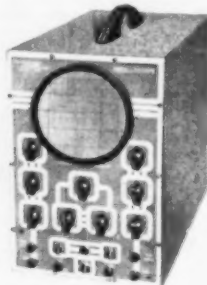
a 300 ohm line with negligible impedance variation throughout the television spectrum. It is constructed of duraluminum and is furnished with an integral 9 foot mast (1 1/2" o.d.) and will fit all rotators commercially available without the need of special adaptors. Half-wave spacing provides low vertical angle of radiation, thus affording maximum signal-to-noise ratio.

TELEVISION SCOPE

Of interest to television technicians is the new Model 425 oscilloscope which is currently being offered by Electronic Instrument Company of 276 Newport Street, Brooklyn, New York.

Probably the outstanding new feature of this instrument is a push-pull horizontal and vertical amplifier. Other features include extremely high sensitivity and wide bandwidth.

The new oscilloscope is available in



kit form (Model 425K) as well as completely assembled.

RUBBER ANODE CONNECTORS

An injection molding process for making anode connectors and other television parts has been developed by Minnesota Rubber and Gasket Co., 3630-V Wooddale Ave., Minneapolis 16, Minnesota.

The manufacturer claims that this molding process enables him to hold to closer dimensions, tolerances, and provide greater uniformity in production than was hitherto possible. A special television rubber compound has been developed to provide heat resistance,



corona resistance, and high dielectric. Special aging chemicals provide good flexibility even after prolonged use.

MAJESTIC CONSOLE

A name long and favorably known in the radio industry has made its reappearance with the debut of the 1950 line of Majestic television receivers.

STAY ON THE AIR[®] WHEN POWER FAILS...with an ONAN Electric Plant



**AUTOMATIC
START & STOP**

Model 10EL, 10KW A.C.

When storms, floods, or fires interrupt electricity and force you off the air, you lose listeners and income. Guard against loss, assure vital public service during emergencies by installing an Onan Electric Plant. Onan Standby Electric plants serve many network and private stations. Automatic models to 35,000 watts.

PORTABLE ELECTRIC PLANTS FOR MOBILE RADIO USES



Supply A.C. power for broadcasting at scene of events. Can be carried by hand or in trunk of car. Weigh as little as 80 pounds. A.C. models 350 to 35,000 watts.

Write for FREE Folder

D. W. ONAN & SONS INC.

4806 Royalston Avenue
Minneapolis 5, Minnesota

NEW for 1950 FACTORY-TO-YOU MIDWEST TELEVISION

NEW GIANT 16" PICTURE TUBE

Immense 151 square-inch screen on new 16" metal glass tube — clear, steady, bright pictures — Synchronized sound and picture that a child can tune in perfectly. Long Distance FM Circuit... Big 12" Electro-Dynamic Fanastic Speaker — Available in complete chassis (not a kit). Buy direct at Low Factory Prices, with Low Down Payment and Long Easy Terms — and an 80 Day Trial! Send for 32-page, 4 color catalog today!

**BUY DIRECT
FROM FACTORY
and SAVE!**



Also a Complete New 1950 Line of
**MIDWEST
RADIOS**
with new long distance
FM Circuit and new
3-Speed Phonograph.

Send This
COUPON
on 1st Post
Card for
NEW 1950
FREE
4 Color
32 Page
MIDWEST
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MIDWEST RADIO & TELEVISION CORP.
Dept. X178, 909 Broadway, Cincinnati 2, Ohio
Please send me your new FREE 1950 Catalog.

NAME _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

RADIO & TELEVISION NEWS

One of the featured sets in the new line is the Model 16C4, a 16" unit with a black tube. Like all of the receivers in the line, this new model has a built-



in "Channelized" antenna which is said to operate satisfactorily in 8 out of 10 locations, and some recent electronic circuit innovations developed by the company.

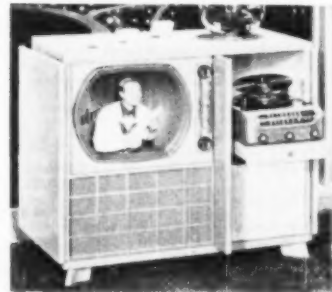
The Model 16C4 is housed in a hand-rubbed mahogany cabinet and is also available in blonde mahogany as the Model 16C5.

The new Majestic Radio and Television Corporation, headed by Leonard Ashbach, has headquarters at 743 N. La Salle Street in Chicago.

SIX-WAY CONSOLE

Admiral Corporation of Chicago is marketing a six-way console in its 1950 line of home radio instruments.

This unit, which uses a 19-inch picture tube, features a Dynamagic FM-AM radio with 12-inch speakers as well as the company's three-speed record changer which handles 33 1/3, 45, and 78 r.p.m. records on a single spindle. The changer will handle from 12 to 14 records at a time, depending on their size. Both the radio and record



player slide out from the cabinet when in use for easy accessibility.

The cabinet, of hand-rubbed wood, comes in either blonde or mahogany finishes.

INDOOR ANTENNA

Tricraft Products Company of 1535 North Ashland Avenue, Chicago, Illinois, is currently in production on a new indoor television antenna, the "Vidiette" Model "700."

According to the company there is

March, 1950

NEW LOW PRICES TRANSMITTERS AND RECEIVERS:

	USED	NEW
BC-493 Receiver—120-550 KC.	\$11.95	
BC-493 Receiver—5-9 MC.	6.95	
BC-494 Receiver—1-4 MC.	4.95	
Transmitter 1-4 MC. Rec. Sec.		\$3.00
NH 100 below		
	USED	NEW
BC-496 Transmitter—2-4 MC.	\$12.95	
BC-496 Transmitter—5-9 MC.	9.95	\$14.95
BC-497 Transmitter—1-4 MC.	6.95	9.95
BC-498 Transmitter—5-9 MC.	5.95	8.95
BC-499 Transmitter Modulator	1.95	2.95
Transmitter 1-4 MC. Trans. Rec.		
NH 100 below		6.90
Choke—15 Hs. 250 MA. No.		
NH 121		4.95

BC-223 TRANSMITTER

30 Watt Transmitter with crystal or MO control on four pre-selected channels. 2000 to 5250 KC. by use of three plug-in coils. Five Tubes, 2-801 & 2-4-4. With TU-17 Tuning Unit 2000 to 5250 KC. a 0.1 cable. Low Mfg. Prices.

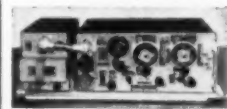
NEW \$24.95
USED \$19.95

TUNING UNITS: TU-17 2-4.5 MC. TU-22 4.5 to 5.3 MC. Either: NEW \$3.50 USED \$2.50

PE-125 VIBRATOR POWER SUPPLY For BC-223 Transmitter. 12-24 Volts. 150 MA. Price: NEW \$9.95 USED \$7.95
CABLE only Trans. to Power Supply \$1.75

MARK II B-19 TRANSMITTER AND RECEIVING SET

15 TUBES 2-8 MC., 240 MC., and INTERCOM. IDEAL FOR MOBILE OR STATIONARY USE!



Set transmits and receives 2 to 8 MC. Phone, C.W. and M.C.W. 25 Watt Master Oscillator Control. Transmits and receives 140 S.V. Phone. Also an intercommunicating set. Comes complete with 15 Tubes, Headset, Microphone, Antenna Control Box, 12-24 Volts. Power Supply, and other accessories. Set sells for \$25.00. NEW \$39.50 USED \$29.50

Also Available: All Parts and Accessories for B-19 Mark II Set

NEW TRANSFORMERS And CHOKES

ALL FOLLOWING TRANSFORMERS—CASED
115 V.A.C. 60 CYCLE INPUT:

OUTPUT 250-0-250 V.A.C. 600 V D.C. after choke
Input filter at 250 MA. Includes 0.5 V.A.C. winding at 5 amperes and 5.0 V.A.C. winding at 4 amperes. \$7.95
OUTPUT 425-0-425 V.A.C. 1000 V D.C. after choke
Input filter at 250 MA. Includes 0.5 V.A.C. winding at 5 amperes and 5.0 V.A.C. winding at 4 amperes. \$7.95
OUTPUT 600-0-600 V.A.C. at 250 MA. 12 V.A.C. at 5 amperes, 12 V.A.C. at 3 amperes and 5 V.A.C. at 3 amperes.
Designed for Acme surplus transmitters. \$6.90
OUTPUT 250-0-250 V.A.C. at 60 MA. 24 V.A.C. at 6 amperes, 3.3 V.A.C. at 5 amperes. Designed for Acme surplus receivers. \$3.00
OUTPUT 6.2 V.A.C. at 8 amperes. NH-109. \$2.25
OUTPUT 2.5 V.A.C. at 10 amperes, center tapped and shielded.
Open frame mounting insulated for continuous operation at 5,000 cycles. NH-113. \$4.20

TRANSFORMERS

115 V. 60 CYCLE PHIMARIES:
SEC. 1.00
12 V. 1 amp. \$1.50 24 V. 2 amperes \$2.25
24 V. 1 amp. 1.95 24 V. 3 amperes 1.50
Sec. 24 V.A.C. 2.5 amperes 2.95
Sec. 24-14 or 28 V. 75 or 150 mA. 4.95

CHOKES—CASED:

NH-115—8 Henries at 300 MA. after choke, 5,000 cycle insulation. \$9.95
NH-116—5-20 Henry 500 MA. winding choke and coil insulation. \$9.95
NH-117—8 Henries at 700 MA. after choke, 5,000 cycle insulation. \$14.95
NH-118—5-20 Henries at 700 MA. winding choke and coil insulation. \$14.95
NH-121—13 Henries at 250 MA. after choke, 5,000 cycle insulation. \$4.95
NH-122—4-12 Henries at 250 MA. after choke, 5,000 cycle insulation. \$4.95
PAE-1 Portable ELECTRIC MEGAPHONE EQUIP. Complete w/ 4 V. DC. battery and 110 Volt AC charging rack. Price \$39.95

GEARED MOTOR

Ideal reversible motor for rotating antennas, dials, etc. Weight: 4 lbs. Overall size: 7" long, 4" dia. Case: 3 1/2" x 2 1/2" x 1 1/2". Motor size: 3/8" x 1/2" x 1/2". Shaft size: 3/8" x 1/2". Operates from 24 volt DC, 2.0 A., or 36 volt AC at 75 lbs. per inch torque. Price \$5.95
TRANSFORMER—115 Volt 60 cycle primary; secondary 36 volt AC. Price \$2.95

Address DEPT. RN • Minimum Order \$2.00 • Prices F.O.B., Lima • 25% Deposit on C.O.D. Orders

BLOWERS:

110 VOLT 60 CYCLE (Plastic):
4" Intake 2" outlet. Approx. 100 CFM. 17" dia. Motor 7 1/2" dia. 1700 RPM. Motor running. Prices: NEW \$6.95 Motor only \$3.95
24 VOLT DC or 36 VOLT AC 4" Intake 2" outlet. Approx. 200 CFM. 17" dia. Motor 7 1/2" dia. 1700 RPM. Motor running. Prices: NEW \$9.95 Motor only \$5.95
4 VOLT DC CAR DEFROSTER KIT—complete with Hose, Blower, Hardware, and instructions for easy installation. Price \$4.95

RC-645-A TRANSCEIVER—ALSO

110 VOLT TRANSMITTER AND CHOKE

15 Tube Transceiver. Ideal for conversion to 400 MC. Frequency coverage 400 to 500 MC. With conversion instructions. Price: New and Used \$14.95

TRANSFORMER for RC-645-A—110 Volt 60 cycle input output 400 Volt 150 MA. after filter, 12, 9, and 6 V. AC. 4 amperes and 3 V. amperes. No. NH-645. Price \$6.95
CHOKE—15 Hs. 150 MA. Under No. NH-646. 2.95
PE-101 DYNAMOTOR 12-24 V. Input. Price 2.95

TELETYPE TRANSMITTER AND INDICATOR SYSTEM—Ideal for antenna direction indicator to remote position. Complete with Antenna Transmitter, 2" 1-1/2" Indicator, Transmitter, and instructions. Price \$6.75
Antenna Trans. only \$2.95 Plug 1-1/2" \$1.00

CONDENSER ASSEMBLIES:

5 Gang with center tuning. 25 MMFD to 40 MMFD each section. Size: 7 1/2" x 3 1/2" x 3 1/2". Price \$2.95
5 Gang Condenser. 25 MMFD to 40 MMFD each section. Size: 6 1/2" x 3 1/2" x 3 1/2". Price \$1.95

WHIP ANTENNA EQUIPMENT

MAST BASES—INSULATED:

MP-12—1" heavy coil spring, 2" insulator, overall length 11 1/2". Wt. 2 1/2 lbs. Price \$3.95
MP-22—Spring action direction of bracket, 4" x 2" mounting. Price 2.95
MP-52—1" heavy coil spring, 2" insulator, overall length 11 1/2". Wt. 2 1/2 lbs. Price 2.95
MP-48—2" heavy coil spring, 2" insulator, overall length 11 1/2". Wt. 2 1/2 lbs. Price 2.95
MP-32—2" heavy coil spring, 2" insulator, overall length 11 1/2". Wt. 2 1/2 lbs. Price 2.95
MP-47—2" heavy coil spring, 2" insulator, overall length 11 1/2". Wt. 2 1/2 lbs. Price 2.95

MAST SECTIONS FOR ABOVE BASES:

Tubular steel, upper coated, painted, 3 foot sections, screw-in type. \$8.50 each for 3 foot sections, 10 foot length, with MS 52-51-20-45 for 10 foot sections. Price \$8.00 each
R.H.K. 102 3/4" x 1/2" x 1/2" 5 foot sections \$5.00

DYNAMOTORS:

INPUT	OUTPUT	STOCK NO.	PRICE
12 V. DC	600 V. 250 MA.	DM-100	\$7.95
12 V. DC	600 V. 100 MA.		
6 V. DC	420 V. 40 MA.	DM-100B	3.95
6 V. DC	275 V. 30 MA.	6-Horse	
12 V. DC	420 V. 300 MA.		
12 V. DC	420 V. 100 MA.	DM-100C	9.95
12 V. DC	420 V. 60 MA.	DM-100D	2.95
12 V. DC	420 V. 30 MA.	DM-100E	2.95

PERMANENT MAGNET FIELD DYNAMOTORS:

12-24 V. DC 275 V. 110 MA. USA-0010 3.95
12-24 V. DC 200 V. 50 MA. USA-0015 2.95

PM FIELD DYNAMOTOR POWER SUPPLY—Complete. Has two FM dynamos at 110 V. DC. Price \$5.00

INVERTERS:

25 V. DC 110 V. 1000 V. 200 MA. MG-100P \$14.95
25 V. DC 110 V. 1000 V. 200 MA. 3 Phase 20 V. 1000 V. 200 MA. MG-100P 42.80
25 V. DC 110 V. 1000 V. 200 MA. 1 Phase 20 V. 1000 V. 200 MA. MG-100P 42.80

WRITE FOR QUOTATIONS ON OTHER INVERTER OR DYNAMOTOR NEEDS!

NH-122 Transformer 110-0-110 V. 60 cycle. \$24.95
PAE-1 PORTABLE BATTERY BASE FOR 400 MC. and 110 V. 60 cycle. Price \$24.95
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Save \$27.40 on Complete Unit

Everyone is clamoring for this unit. Consists of the following units: Transmitter/Receiver with plugs, 15 tubes, voice modulated, output 5-watts. PE-62C dynamotor with voltage regulator and filter system and plugs. 24 VDC @ 12 amps input, 300 VDC @ 25 amps, minus 120 VDC @ 61 amps, 14.4 VDC @ 5 amps. RA-62C AC Rectifier Power Supply with input selector switch for AC input voltages of 115 to 250, output supplies transmitter/receiver voltage; size 17" x 11" x 11"

SAVE \$27.40 BY BUYING COMPLETE UNIT **\$219.95**

SEPARATE PARTS PRICE LIST:

SCR-522 Xmitter/Revr \$49.95
PE-62C dynamotor 5.95
RA-62C Pwr. Supply 189.95
SCR-522 Antenna 1.50
\$247.35

BC-929 INDICATOR SCOPE

Wonderful deal for cheap test scope. Contains 8 tubes, 1—6X4, 2—6X5, 2—6X6, 1—6X8, 1—6X9, 1—2X2 and 6X5. Full instructions for use with light bulb.
Excellent condition **\$14.95**

APS-13 TRANS-ALP

While They Last—At This Low Price Tailend Charlie kept the Jam off our list. Now yours at a fraction of original cost! cont. 5 stages of 30 Mhz IF (AGC), 2 stages of video amp, 6AG5 which feed into 2-12T for relay warning. 126H in transmitter-receiver. Just the thing for citizens band, 420 mc ham band, or TV, or use for short range radar detection. Wonderful possibility for marine and small aircraft radar. Tubes alone are worth almost as much as our complete set. To you, good condition. **\$9.95**

BC-906 FREQUENCY METER

A real laboratory instrument at a fraction of original cost. Can be modified for many other uses. Absorption-type. Range 150-225 MC. Power requirements—2 batteries, 1.5V and 45V. Low precision friction-type vernier dial for frequency variation. Black wrinkle-finish metal cabinet with door. Complete with tubes and frequency chart! NEW **\$19.95**

APN-1 ALTIMETER TRANSMITTER

Here's a real buy! 418-402 MC FM. Can be modified for citizens band use. You get 14 tubes and a dynamotor for only **\$6.95**

COMMAND RECEIVERS

Used, Good Condition
Complete with Tubes

BC-450 100-520 KC (Q-Ser) \$12.95
BC-454 3rd MC (75 M REVR) 8.95
BC-455 6-9 MC (40 M REVR) 6.95

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COMMAND XMITTERS—ARC-5 & ATA
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BC-459 7-9 MC (Excell cond) \$12.95
BC-457 4-5 MC (Excell cond) 3.95
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BC-221 FREQUENCY METER

Don't pass this up! They're all reconditioned and guaranteed in perfect operating condition. 4 crystal-calibrated in all ranges: 125-250 KC and 2000-4000 KC. These frequency meters are just the thing for use as signal generators and VFO. Remember they've been electrically and physically inspected. Just 1.60 each—no hurry and order yours today—now! Complete with tubes, crystal **\$69.50** and calibration book

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BC-1296 REVR, Remco Revr 200 to 400 KC, 2x5 plate w/d filament. Easily converted to broadcast band by adjusting of slug and tuned coils. A cheap 12-er. Each **\$5.95**

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no pushing or pulling of rods with this unit, a simple movement of the knob to the desired channel is all that is required. The television receiver is then automatically electrically tuned in to the proper station. The unit is small and compact, making it suitable for installation in apartments and other limited-space locations.

"TENNA-ROTOR"

Production is underway at the Alliance Manufacturing Company's Al-



liance, Ohio plant on a deluxe model of the company's "Tenna-Rotor," the Model DIR.

The new unit features a directional

indicator control case. An indicator dial on the control case panel enables the television viewer to select and know the actual compass direction to which the antenna is pointed.

Like the company's standard model, the new rotator is factory lubricated for life, has stainless steel bearing inserts, and is designed to operate in any weather.

Both the deluxe and standard models come with special 4-conductor cable. The cable has a special "zip" feature which facilitates installation.

ANTENAPLEX SYSTEM

The Engineering Products Department of Radio Corporation of America has announced that the company's Television Antennaplex System is now available for installation in television areas throughout the nation.

Originally restricted to distribution on the Eastern Seaboard, the system is designed as a multiple-outlet antenna unit for apartment houses, hotels, stores, schools, hospitals, and office buildings. The system consists essentially of an individually tuned antenna for each transmitting channel in the given area, a master signal am-

TV SERVICE CONTRACT PRICES CUT

By ROBERT HERTZBERG

IN line with the trend toward lower prices for television receivers in 1950, the RCA Service Co., a subsidiary of RCA-Victor, has announced a series of new low-cost TV service contracts. This move will undoubtedly establish a new price pattern for the entire television-servicing industry.

The initial reaction of many TV technicians to the "cut" was dismay. "We're taking a licking now on many contracts," they said. "How will we make out if we charge less?" Study of the new RCA schedule reveals, however, that it will benefit the trade rather than hurt it. The outstanding feature is the restriction of the much-abused "unlimited service" privilege to 90 days, with a flat charge of \$5.75 for all calls after that period. The rates vary from \$22.95 for a 10-inch set with built-in aerial to \$69.95 for projection models with outdoor antennas. Unlimited service contracts at the higher prices heretofore in effect will still be available to customers willing to pay for them.

In announcing the new contract plans, Charles M. Odorizzi, vice-president of RCA in charge of service activities, disclosed that the RCA Service Co. is moving along various fronts to help all service organizations and technicians to keep pace with the rapidly expanding industry. Service notes are being distributed at no charge to recognized organizations, and at a very nominal charge to individual technicians. In addition, a series of six lectures on the practical aspects of TV servicing will be held in various parts of the country during the year, under the auspices of RCA dealers.

"We regard our activities as broader in scope than merely the installation and servicing of RCA and RCA-Victor products," says Mr. Odorizzi. "They are also designed to advance the whole industry, since whatever helps build

public acceptance for television will contribute to the sales of all manufacturers and build volume business for all servicing agencies. Our aim is to maintain friendly and cooperative relations with other servicing organizations."

Newly revised factory service contract price list recently released by RCA Victor. This schedule applies to both commercial and residential installations. The adjustments made for various "zones" applies to distances from the transmitter. Thus, Zone A is normally a 22 to 25 mile radius around a TV station, established by 500 microvolt range of the station. Zone B is normally about 10 miles beyond Zone A, while Zone C is normally 10 miles beyond Zone B.

	PLAN I		PLAN II	
	• Complete installation • Inspection of system • Parts and labor protection, including portable radio, for one full year • Connected service for 90 days • Know 90 days. Service is limited by RCA factory technicians at preferred flat rate of \$5.75 per call	• Complete installation • Inspection of system • Parts and labor protection, including portable radio, for one full year • Connected service for a full year		
TELEVISION TYPE	With Built-In Aerials	With Standard Indoor Aerials	With Built-In Aerials	With Standard Indoor Aerials
TELEVISION SETS				
All 10" Models	\$ 22.95	\$ 39.95	\$ 45.00	\$ 65.00
All 12½" Models	24.95	44.95	50.00	70.00
All 16" Models	29.95	49.95	60.00	80.00
Projection Models	39.95	59.95	75.00	95.00
TELEVISION CONSOLES				
All 10" Models	\$ 29.95	\$ 49.95	\$ 60.00	\$ 80.00
All 12½" Models	34.95	54.95	65.00	85.00
All 16" Models	39.95	59.95	75.00	95.00
Projection Models	49.95	69.95	90.00	110.00

Above prices apply for Zone A. For Zone B add \$7.50, for Zone C add \$15.00.
*Single in America prices apply when packing antenna is used.
*Portable Indoor Antenna Supplied on Request—\$2.50



THERE'S ONLY ONE NIAGARA FOR GREAT RADIO VALUES

For Complete List of Tube Prices
See Feb. Issue of This Publication.



HEART OF THE BC-221 FREQUENCY METER

This VFO Sub-Assembly, used in BC-221 Freq. Meter, is ideally suited for home construction of:

- 1—Amateur V.F.O.
- 2—Freq. Mtr. Foundation
- 3—Portable Transmitter
- 4—Replacement for BC-221

Unit contains two temperature & moisture compensating coils, water switch, 3 variable condensers, carbon resistors, & silver mica condensers. FULLY WIRED & mounted on sturdy aluminum sub-chassis, ready for installation. Brand new—in original packing.

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6X1228	6F728
6X1328	6G728
6X1428	6H728
6X1528	6I728
6X1628	6J728
6X1728	6K728
6X1828	6L728
6X1928	6M728
6X2028	6N728
6X2128	6O728
6X2228	6P728
6X2328	6Q728
6X2428	6R728
6X2528	6S728
6X2628	6T728
6X2728	6U728
6X2828	6V728
6X2928	6W728
6X3028	6X728
6X3128	6Y728
6X3228	6Z728
6X3328	6AA728
6X3428	6AB728
6X3528	6AC728
6X3628	6AD728
6X3728	6AE728
6X3828	6AF728
6X3928	6AG728
6X4028	6AH728
6X4128	6AI728
6X4228	6AJ728
6X4328	6AK728
6X4428	6AL728
6X4528	6AM728
6X4628	6AN728
6X4728	6AO728
6X4828	6AP728
6X4928	6AQ728
6X5028	6AR728
6X5128	6AS728
6X5228	6AT728
6X5328	6AU728
6X5428	6AV728
6X5528	6AW728
6X5628	6AX728
6X5728	6AY728
6X5828	6AZ728
6X5928	6BA728
6X6028	6BB728
6X6128	6BC728
6X6228	6BD728
6X6328	6BE728
6X6428	6BF728
6X6528	6BG728
6X6628	6BH728
6X6728	6BI728
6X6828	6BJ728
6X6928	6BK728
6X7028	6BL728
6X7128	6BM728
6X7228	6BN728
6X7328	6BO728
6X7428	6BP728
6X7528	6BQ728
6X7628	6BR728
6X7728	6BS728
6X7828	6BT728
6X7928	6BU728
6X8028	6BV728
6X8128	6BW728
6X8228	6BX728
6X8328	6BY728
6X8428	6BZ728
6X8528	6CA728
6X8628	6CB728
6X8728	6CC728
6X8828	6CD728
6X8928	6CE728
6X9028	6CF728
6X9128	6CG728
6X9228	6CH728
6X9328	6CI728
6X9428	6CJ728
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TV SCOOPS!

For Hams— DON'T BE BLAMED FOR TV!

F.C.C. tests have proven that the new Low-Pass Filter Kit,* developed by W2GX, attenuates all frequencies above 40 MCS. This "M" derived filter for 160 through 10 meters prevents TVI



while you're operating. Eliminates all frequencies above 40 MCS at 60 DB or better, passes all frequencies below 40 MCS. Fits any 52-72 ohm feeders. Insertion loss less than 1 db at 1 DB. Full directions included.

Cat. No. N-279.

\$4.99 plus 25c shipping charges in U.S.

* Hi and Low Pass Filters manufactured by a division of Niagara Radio Supply Corp. Dealer inquiries invited.

For Servicemen— RCA SOUND POWERED PHONES



Talk up to 10 miles without batteries

MI-2154, with these Cat. No. N-299 sound powered phones. No loss in power

\$9.95 EACH when paralleled. Ample volume, excellent type rubber-cushioned ear phones. Type "Q" has swing-away microphone. Type "O" has mike on chest set. Adjustable headband. Push-to-talk, 22 ft. of live rubber cord and plug on both types. Unit consists of 1 pr. phones, mike, cord and plug as illustrated.



MI-2175 Type "O" Cat. No. N-300 **\$4.95** EACH

For TV Set Owners— Banish Interference



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Niagara's new Hi-Pass Filter Interference kit* is positive protection against amateur and other high frequency RF interference, such as diathermy, etc. Fits any 300 ohm antenna feed line. No loss in pictorial brightness. Easily assembled. Full instructions included.

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MORE BARGAINS IN SURPLUS EQUIPMENT

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MEET THE WINNER! of last month's TALL TALES CONTEST

Walter Berry of Madrid, Iowa, topped them all this month with this tall tale and wins the \$3 prize for March.

"Last winter in Iowa it got so cold my antenna contracted. Only dots went out, dashes stuck in the feeders. When the dots got out the wind blew them back causing the transmission line to explode, scattering dots and dashes all over the yard."

Send your entry in today. It may win!

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This book explains the theory as well as the techniques of television construction, operation, and servicing in the clearest, most practical terms. It gives the radioman all the basic information he needs to meet the increasing demand for skilled television technicians. It shows how and why all modern equipment operates; includes all the essential mathematics and especially good material on antennas. \$7.00

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plifier to boost the signals received on all channels, and one or more vertical lines of coaxial cable, running through pipe wells in the walls, with branch connections for all outlets.

When using this system it is only necessary to plug the receiver's antenna connection into a wall or floor-board outlet in the same way the power cord is plugged into the utility outlet.

TRANS-VUE'S "ARISTOCRAT"

A new 16-inch direct-view consolette which features "eye-level" viewing has been introduced to the trade by Trans-Vue Corporation, 1139 S. Wa-



bash Avenue, Chicago 5, as the "Aristocrat 60L."

The new receiver employs the "Ese-O-Matic" tuner which requires only a single knob control. No vernier adjustment of multiple knobs is necessary on this set. All circuits are adjusted by a single adjustment screw, set at the time of installation.

PHILCO TABLE MODEL

A low-priced table model television receiver which uses a 12½" tube is being offered by Philco Corporation of Philadelphia, Pa., as one of its 1950 line leaders.

Housed in a walnut cabinet, the new model has the Philco Electronic Built-In Aerial System which is claimed to be the only built-in antenna that can



be tuned to match perfectly with any station.

The circuit of this set uses 20 tubes and 2 rectifiers in addition to the cathode-ray tube.

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Radio Men Who Know **SAVE AT SENCO**

RADIO & TELEVISION NEWS

Spot Radio News
(Continued from page 18)

swer to the rambling problems of what to do with color TV and when, how to allocate the ultra-highs and how to orient the present channel setups so that no community suffers from a lack of coverage.

MICROWAVE FACILITIES for TV are rapidly becoming an extremely important factor in relaying, according to the fifteenth annual report of the FCC. Circuits, estimated to cost seventeen million dollars, were authorized during the past year, providing a link between Pittsburgh and Chicago, Chicago and Des Moines, Albany and Syracuse, Richmond and Norfolk, and Milwaukee and Madison.

The report also revealed that as of October 31, outstanding radio authorizations exceeded 737,000, an increase of more than 25,000 in the four months since the close of the fiscal year (June, 1949). In a breakdown of these authorizations, the FCC showed that there were 2299 standard broadcasting stations, 815 FM stations, 112 TV and 217 experimental TV, 589 remote pickups, and 29 studio-to-transmitter setups.

On October 31, the official records showed that over 82,000 had been licensed to operate as amateurs and 194 in the citizens service bands.

In an analysis of the status of TV as of June 30, the report disclosed that actually there were only 13 stations licensed, and 58 were operating on a commercial basis under special temporary authorizations. These 71 stations were, according to the review, bringing reception to 42 cities and metropolitan districts as compared with 17 cities served by 30 stations a year ago. The demand for new stations remained greater than the available facilities, so that 237 of a group of pending applications were in the comparative hearing stage at the conclusion of the fiscal year.

Commenting on the experimental TV services, the report declared that there were 175 experimental stations licensed and 30 outstanding construction permits. Included in these figures were 136 relay stations operating in the microwave region and used primarily as pickup, studio-to-transmitter link and interim intercity relay stations. About 30 authorizations were outstanding in the 475 to 890 mc. band, with activities concentrated on studies of propagation, developments in circuits and tubes for use at the ultra-high frequencies, color transmissions, Phonevision, Stratovision, comparisons with transmission conditions in the present bands, and television relaying.

The clear-channel problem, still to be solved, also received a substantial review in the report. According to the FCC, the matter is now awaiting

...after 9 months of daily use ON 30,000 MILE TREK THROUGH AFRICAN JUNGLE with Arch Oboler

Famous Radio Playwright.

**E-V CARDYNE takes everything...from
the heat and humidity of the Congo to
the rain-swept slopes of the Mountains
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16,000 foot Mt. Kenya's glacier fields!**



Shows Arch Oboler recording Masai savages in Kenya, British East Africa

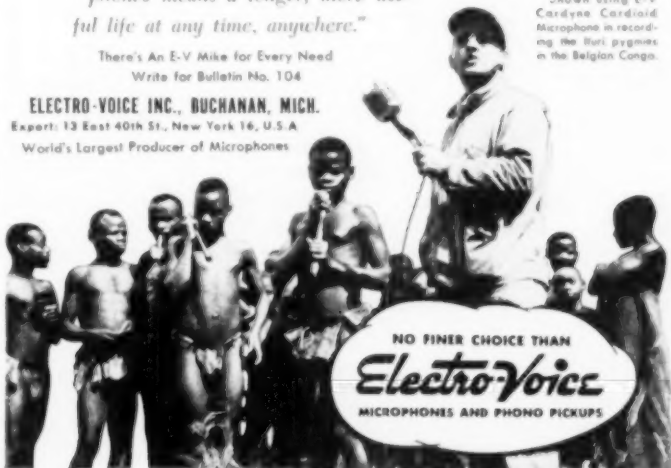
"...trip was made by boat, pack horse, jeep and foot under most difficult conditions...apparatus had to endure penetrating dust and great variations in humidity...used the Cardyne almost entirely...never failed, during months of use and abuse...

made recordings of experiences on African safari...for a series of transcribed radio broadcasts...after return to U.S., found the Cardyne to be in thoroughly operative condition from every standpoint...built-in ruggedness of E-V microphones means a longer, more useful life at any time, anywhere."

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BODY MOUNTS: Swivel Base (A) Mod. 126, straight spring (B) Mod. 132, double tapered spring ship. wt. 5 1/2 lbs. **\$3.95**

Net price each **\$7.95**
BUMPER MOUNTS: (C) Mod. 139, straight
 spring (E) Mod. 140, double tapered spring
 Shing wt. 3 to lbs. **\$2.50**

Net price each **\$5.95**
 (D) Mod. 142, less spring insulated for direct mounting for Series 100 Antenna or Extension 92.

ships wt 2 lbs. **\$2.95**
Net price
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McCONNELL'S 3834 Germantown Ave. standards 2 pin holder
 Phila., Penna. RA 5-6033 **XTALS 500KC** CN-28 U brand new \$1.50

(In a commentary on the "super power issue," made during the Federal Communications Bar Association annual meeting referred to previously, Senator Johnson said: "I hope that the Commission will shortly provide for duplication of clears since the people of this country need more frequencies desperately. Certainly it has the authority to do so. The maintenance of clear channels is an anachronism in modern radio practice. . . . Unfortunately the clears cannot render the local service that many areas deserve, hence they do not serve well. It is archaic to contend any longer that clear channels serve a useful purpose in the country, and the best proof is that the networks now frankly admit that their own seaboard clears might be duplicated without harm to them.")

An interesting dissertation on the operations of the technical information and laboratory divisions of the FCC also appeared in the annual report. In a review of the technical studies probed by the Commission, it was disclosed that radiation and interference received intensive surveying, particularly insofar as television receivers were concerned. The report stated the number of complaints of TVI received by the field division increased far beyond anything anticipated. A study was therefore undertaken to determine the technical phases of TVI, and since the problem is quite complex, a great deal of testing and research will be required before practical solutions can be reached.

The possibilities of single sideband, suppressed carrier applications were also covered in the report. With the ever-increasing demand for frequency space, engineers have turned to the

single sideband, suppressed carrier method of operation because it offers a saving in the bandwidth requirements. Many technical questions have arisen concerning the actual bandwidth needed for various types of modulation, methods of calculating and specifying power, and so on. The study of these problems was started early in '49 and will probably be continued next year, the annual review declared.

Eight extensive projects involved in determining the over-all frequency characteristics of the low and high bands of television, the responsibility of the FCC lab groups, were also discussed in the report: A study of the effects of the variable hydrographic conditions on wave propagation; a study of terrain effects upon wave propagation; a study of surface coverage (trees, shrubs, etc.) and their effect upon propagation; analytical studies of tropospheric interference; tropospheric interference studies in the ultra-high bands; tropospheric interference standards for the very-high fixed and mobile services; a study of scatter effect and its probable impact on the present and future high bands for TV; and the development of automatic devices to scale field charts and analyze the resulting data.

In the letter of transmittal of the report to Congress, Wayne Coy, FCC Chairman, accented the growing importance of TV by declaring: "Broadcast activities are marked by the booming interest in television, and the attendant problems being dealt with by the Commission in order to meet the demand for video expansion and improvement."

AFTER THIRTY-THREE years at the Bell Labs, during which the world saw a continuous procession of brilliant contributions to the science of acoustics, Harvey Fletcher has retired. Fortunately his retirement is but a transfer of operations, for he will now concentrate on education and serve as an honorary professor in the electrical engineering department of Columbia University, in charge of a department of acoustical engineering. Good luck, Doc. . . . L.W.

SET PRODUCTION

THE recently-released report on set production by RMA member-companies reveals that 9,680,773 radio receivers of all types were manufactured during 1949 by such companies.

Television set production totaled 2,413,897 with 121,238 sets in January 1949, 118,938 in February, 182,361 in March, 166,536 in April, 163,262 in May, 160,736 in June, 79,531 in July, 185,766 in August, 224,532 in September, 304,773 in October, 414,223 in November, and 292,061 in December. Approximately 20 per-cent should be added to the totals in order to compensate for sets produced by non-RMA companies. This brings the over-all television receiver production for 1949 to 2,896,676 sets.

FM-AM and FM sets totaled approximately 963,655 and AM sets 7,030,508 for all companies.

-50-

March, 1950



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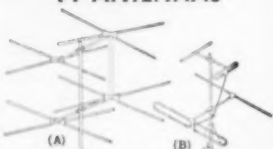
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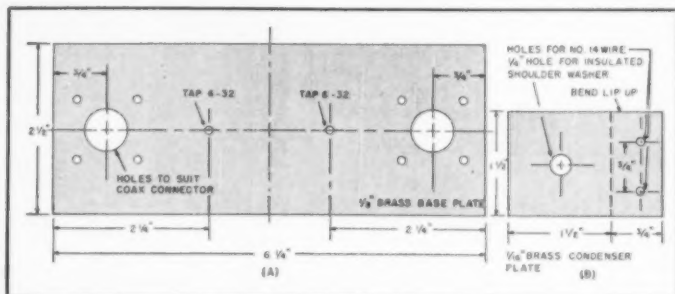
TVI Filter

(Continued from page 61)

portant, very low inductance. The design capacity of each plate-type condenser is 141 μ fd. The actual capacity should agree within 10% of this figure and should be adjusted experimentally, stacking mica sheets for the dielectric until approximately the correct capacity is attained. A "Q"-meter is ideal for this adjustment but the transmitter v.f.o. may be used, comparing the frequency change produced by the addition of the plate condenser to the

denser assembly is shown in the photograph appearing on page 61.

The self-supporting coils are wound of number 14 wire on a $\frac{1}{2}$ " form, and the form then removed. It is best to check the inductances but this is not absolutely necessary provided the dimensions and photographs are followed closely. Small variations in the individual elements will only slightly modify the transmission characteristic of the filter. For instance, no perceptible change was produced when the sheet-copper shield was removed. Coupling between elements, principally magnetic coupling between the coils, should be minimized. Mounting the



Details for laying out and drilling the brass plate on which filter is assembled.

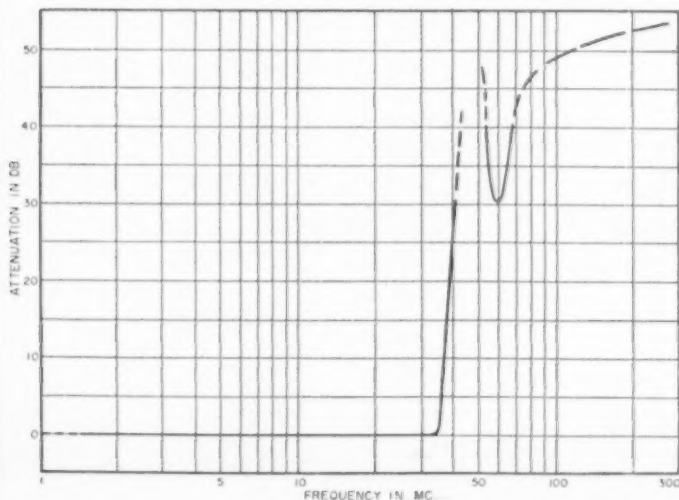
change produced by the addition of a mica or variable condenser of 140 μ fd. In the filter pictured, the mica is stacked to a total thickness of .013", using three or four sheets of .003-.004 mica.² A sawcut $\frac{3}{8}$ " deep and $\frac{1}{4}$ " in from the edge of each plate forms a small tab which may be bent up or down for small variations in the capacity. The over-all view of con-

coils as shown will produce negligible magnetic coupling.

Although it has not been tested, an acceptable substitute for the sheet mica should be celluloid or old photographic negatives. The latter should have the emulsion removed by a bath of hot water. These materials are inferior to mica in dielectric strength and power factor but should be usable for moderate power applications.

² Mica may be obtained from Mica Insulation Co., 1276 W. Third St., Cleveland, Ohio.

Transmission characteristics of the TVI filter plotted from 2 to 200 mc.



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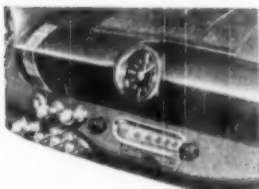


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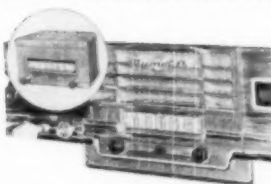


1949 and 1950 FORD AUTO RADIOS



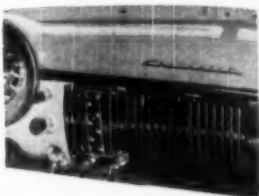
Six-tube superheterodyne. Six volt storage battery operation. Two dual purpose tubes. Eight tube performance. Specifically designed to fit all 1949 and 1950 Ford cars. Features two unit construction. No hole drilling required for mounting. Installation in a few minutes. Three-gang tuning condenser and tuned R. F. stage for extreme sensitivity. Permanent magnet dynamic speaker with powerful Alnico #5 magnet. Low battery drain. Weight 10 lbs.

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"TELEVISION EXPERT"

"Here's How to be a Television Expert" is the title of a 23-page, two-color booklet published by Motorola Inc. and available at dealers.

Of modern design, the booklet's main theme is an elementary explanation of television, its production, its reception, history, and how the networks are made, etc. Numerous sketches are used to illustrate the answers to those questions most often asked about television by the layman.

The booklet is not designed as promotional literature and may, therefore, be used as an educational piece in schools or for any group interested in learning about television.

ACCESSORY PRODUCTS

Three types of biconical television aerials, six handy alignment jigs for servicing Philco television receivers, a three-speed record changer, and 45 r.p.m. record adapter disc and non-slip driver are among the new accessory products described in a series of data sheets available from the Accessory Division of Philco Corporation, Philadelphia, Pennsylvania.

Detailed descriptions of these products as well as an isolation probe used with the company's Electronic Circuit Master, Model 7001, are covered in these bulletins.

For information on the isolation probe ask for the bulletin on Part No. 43-5127; on the automatic record changer (Model M-20) the bulletin on Part No. 45-9566-1; on the biconical television aerials and the television alignment jigs ask for the bulletins by name.

TRANSFORMER CATALOGUE

A new transformer catalogue which lists a complete line of transformers for broadcasting and other professional applications as well as for amplifier constructors, audio enthusiasts, the replacement field, and hams, has just been published by Peerless Electric Products Division of Altec Lansing Corporation, 161 Sixth Avenue, New York 13, New York.

The line includes output, input, interstage, plate and filament, power smoothing and swinging chokes, modulation and replacement types. Also listed are several new additions to the company's line including power transformers, television receiver power transformers and chokes, matching transformers for the 70 volt RMA standard line as well as the conventional 500 ohm distribution line, output transformers for the Type

2A3 tubes, a new output transformer for push-pull parallel 6L6 tubes with secondary for the new RMA 70 volt line as well as voice coils, etc.

SELF-LOCKING NUTS

A new 4-page folder prepared especially for design engineers and production men is currently available from The Palnut Company, 23 Corridor Street, Irvington 11, New Jersey.

Details of construction savings and assembly with the company's washer-type, self-locking nuts on sheet metal products, decorative parts, and components are given in the booklet. The material included covers assembly procedures and methods of application on electrical equipment, radio, television, ranges, etc.

Pertinent dimensions, screw tension figures, materials, and finishes are also included to provide complete data for the engineer.

AUDIO EQUIPMENT

Laboratory instruments, potentiometers, decades, gain sets, precision resistors, and other products used in the audio field are covered in a new 40-page catalogue published by Cinema Engineering Co. of 1510 W. Verdugo Ave., Burbank, California.

Included in Catalogue No. 11-A are graphs and tables for computing attenuators and branching networks. Complete technical tables cover precision wirewound resistors in four different alloys of wire. There is also a listing of laboratory patch panels, cords, jacks, and transmission lines. The material is illustrated with charts, diagrams, mixer circuit, schematic drawings, and attenuator formulas.

TV PARTY BOOK

On the premise that much of today's home entertaining revolves around the television receiver, Starrett Television Corporation of 601 West 26th Street, New York 1, New York, has issued a 24-page booklet entitled "21 Terrific Television Parties."

This handy little publication offers 21 new television games including charades, quizzes, puzzles, anagrams, spelling bees, "name" games, definitions, hidden term games, Valentine and Anniversary games, etc.—all pertaining to home television viewing and entertaining. Answers and results are provided in a back section of the booklet and, in addition, detailed suggestions for invitations, refreshments, home decorations, and

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 WESTON TACHOMETER GENERATOR. **NEW 16.75**
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BC-164 TARGIT RECEIVER—5 Channel remote, battery case, antenna 68-73 MC. **\$14.95**

INTERPHONE AMPLIFIER—CMX5012-A, 12 V. 6 Watts P.O. T.C.S. Equipment—tubes and dynamo. **\$5.50**

HANDY-TALKIE Crystal and Coil Sets—3885 K.C. to 5,500 K.C. Specify Frequency. 2 crystals and 2 coils per set. **NEW 2.35**

PE-103 DYNAMOTOR POWER SUPPLY—COMPLETE with dynamotor, filter, relay unit, battery cable, and shock mount. Part of SCR-284. BRAND NEW **\$19.50**

BC-620 Mobile FM Transceiver—P. O. SCR-610. Includes 18 meter band. Excellent condition with tubes. **\$11.05**
 PE-120 Power supply with tubes—Excellent condition. **\$5.50**
 Combination BC-620 and PE-120. Both for **14.05**

FL-8 Range Filter—NEW **\$1.95**
 HS-21 HEADSET—BRAND NEW 6,000. **2.45**
 HS-23 HEADSET—With ear pads. **1.29**
 HS-30 HEADSET—Complete with matching transformer, 6' cord and PL-53 plug. **NEW 1.95**
 HS-30 HEADSET—NEW **.95**
 DYNAMIC HEADSET AND MIKE—P.O. Mark II. **NEW 1.95**
 HEADSET EXTENSION CORD—CD-307A with PL-53 and JK-16. **.49**
 HEADSET ADAPTER MC-3850—High to low impedance. **NEW .35**
 T-32 DESK MIKE. USED **\$1.05** NEW **3.00**

MC-26C—BENDIX RADIO COMPASS, RECV. 150-1,500 K.C. Tubes—Excellent cond. **\$17.50**

TRANSFORMERS—6200 V. @ 325 ma. secondary—single C.T. for 3100-0-3100 @ 650 ma.—Primary 105/110-115 @ 60 cycles—American Transformer Company. **NEW \$39.50**
 2.5 V. @ 10 amps. C.T.—15,000 volt insulation—115 V. A.C. primary—Roxton S-9482. **5.99**
 200-0-200 @ 50 ma.—6.3 V. @ 3 amps.—115 V. A.C. Primary. **NEW 1.95**
 115 V. A.C. Primary—00 volts C.T. @ 0.75 amps; 6.3 V. @ 1.2 amps; 5 V. @ 2 amps E.A. **2.25**
 WELDING TYPE W. TRANSFORMER—100 amps. mfg. with secondary—115 V. A.C. primary. **NEW 16.95**
 American Transformer Co.

INTERPHONE AMPLIFIER—BC-709—Ideal for Aircraft, booster for telephone system, etc. **NEW \$4.50**

400 Cycle INVERTER—G.E. 5621N31A. Input 27 V. 35 amps. Output 115 V. 1.2 amp. single phase. **\$12.50**
400 Cycle INVERTER—G.E. PE-218 Input 27 V. 100 amps. Output 115 V. 1.5 amp. V.A. single phase. **29.50**
800 Cycle INVERTER—PE-206. **NEW 9.95**
800 Cycle Blower and Motor—1 ph 6-700 R.P.M. 120 V. CAV-277-3. **2.50**
24 V. D.C. Blower and Motor—1700 R.P.M.—1.25 amps. A.G. Redmond Co. **1.95**

6CF1—5" CATHODE RAY TUBE. **\$1.45 each**
 4 for \$4.25

APN-1 AT-TIMER INDICATOR, basic movement 0-1 ma., 5 ma. shunt, 270° dial. An excellent basic movement for constructing your own meters. **NEW \$1.95**
METER RECTIFIER, full wave midgeit selenium, 10 volts, 20 ma. **.29**
APN-1 AT-TIMER, Complete. **NEW 24.50**
 I.F. Transformer—1st, 2nd or 3rd, from SCR-522, 12,000 K.C. Iron core tuning, can be tuned to television I.F. Frequency by removing padding core. **3 for \$1.00** EACH **.35**

BC-318 Mounting Base. **\$2.25**
BC-348 Outlet Plug. **.59**
BC-348 Mounting Base and Outlet Plug. **2.50**

TEST EQUIPMENT
 RE-221 Plug Meter—25 K.C. to 20,000 K.C. Excellent Condition. **\$69.50**
 F-22 Signal Generator by Kopy Mfg. Co. **79.50**
 TR-64 AP Portable Oscillograph made by Western Electric, Ramsey condition. **250.00**
 RE-103 Test set for RE-221, Complete. **250.00**

IDEAL MOBILE POWER SUPPLY
 PE-237 Heavy duty vibrator power supply 6, 12, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530, 540, 550, 560, 570, 580, 590, 600, 610, 620, 630, 640, 650, 660, 670, 680, 690, 700, 710, 720, 730, 740, 750, 760, 770, 780, 790, 800, 810, 820, 830, 840, 850, 860, 870, 880, 890, 900, 910, 920, 930, 940, 950, 960, 970, 980, 990, 1000. **BRAND NEW \$27.50**

MINE DETECTOR—G.E. 6225A Used for locating landmines, underwater pipes, gold, etc. **\$59.50**
 NEW WITH MANUAL. **19.50**
 USED EXCELLENT COND. **19.50**

REPAIR RADIO CONVERSION MANUAL, Vol. 1. 115 pages of circuits and data. **\$2.50**
 CD-503 CABLE for PE-103 BC-654. **NEW 1.85**

SPARKER-6" P.M. Compartment, 25 watts, 36-5,000 ohms. Waterproof. Excellent Used. **6.95**

TERMS: Prices f.o.b. Pasadena, 25% on all C.O.D. orders. California add 3% sales tax.

RADAR, COMMUNICATIONS AND SONAR TECHNICIANS W-A-N-T-E-D For Overseas Assignments

Technical Qualifications:

1. At least 3 years practical experience in installation and maintenance.
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3. Army veterans TECH/SGT or higher.

Personal Qualifications:

1. Age, over 22—must pass physical examination.
2. Ability to assume responsibility.
3. Must stand thorough character investigation.
4. Willing to go overseas for 1 year.

Base pay, Bonus, Living Allowance, Vacation add-up to \$7,000.00 per year. Permanent connection with company possible.

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Men qualified in RADAR COMMUNICATIONS or SONAR give complete history. Interview will be arranged for successful applicants.

MAGNERASER

**FOR 100% TAPE ERASURE
WITHIN SECONDS**

Erases all brands of magnetic tape—even when severely overloaded, and actually lowers the noise level 3 to 4 db. Below that of unused tape! If you operate any tape recorder, you should have a MAGNERASER for quick, 100% complete tape erasure. Safely push-button prevents accidental erasure. Also invaluable for demagnetizing record-playback and erase heads. Operates on 100 to 130 volts, 25, 50 or 60 cycle current. Weights 2½ lbs. Size 4½ x 2 inches.

Net Price \$18.00

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WITHOUT NERVOUS TENSION

REVEALING BOOK shows how "crack" operators develop high speed and proficiency. Learn code for Amateur or Commercial Radiotelegraph License, or improve your sending and receiving with the Candler System, which develops radiotelegraph experts and

CANDLER SYSTEM

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What's New in Radio (Continued from page 80)

tricle eye) which makes perfect recording every time.

The "Reelest" has been designed for easy portability. The specially designed case permits the unit to operate with the top cover down while all controls are accessible for operation. A hinged flap protects the controls as well as providing space for cord and microphone when the unit is being carried.

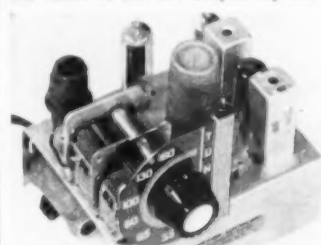
For full particulars or additional data, requests for this information should be addressed to Department E-4 of the company.

MINIATURE BC TUNER

Approved Electronic Instrument Corp. of 142 Liberty Street, New York 6, New York, is currently marketing a miniature superheterodyne broadcast tuner which has been designated the Model A-600 AC.

The circuit of the tuner is a standard superheterodyne using miniature tubes. The power supply is a standard 117 volt, 60-cycle full-wave rectifier. A power transformer isolates the line from the chassis, thus eliminating shock hazards.

The output cable is attached within the tuner to the low output tap but if



higher output is desired connection can be made to the medium or high output taps.

Since the unit measures only 4" x 4" x 5" and weighs 2½ pounds, it is ideally suited for applications where space is at a premium.

SEMI-FLEXIBLE COAX

Andrew Corporation, 363 East 75th Street, Chicago 19, Illinois, now has available a ¾" diameter, semi-flexible coaxial cable (Type 83) for connecting transmitters to antennas in installations of 300 watts or less, to connect communications receivers to antennas, and to connect the phase sampling pick-up device to the phase monitor in broadcast directional systems.

The outer conductor material is a soft-temper copper tubing which is easily bent by hand although the company does not recommend repeated flexure. The cable is easily uncoiled and laid in place and, once installed,

Look for the

**QUAM
FOCALIZER
UNIT**

in better television receivers!



The new QUAM FOCALIZER UNIT, utilizing Alnico permanent magnets instead of the more expensive and less stable wire wound construction, not only provides better, sharper focus of the television image, but is unaffected by operating temperature and voltage fluctuations.

With a QUAM Focalizer Unit in the set it is unnecessary to refocus the image because the coil has heated, increasing resistance and weakening the magnetic field. Since there is no wiring, voltage fluctuations have no effect on the operation of the QUAM Focalizer.



Focusing is done upon installation of the set by a simple operation—it is then permanent! You will find the QUAM Focalizing Unit in the better Television Receivers.

THE QUAM ION TRAP

The improved and simplified construction of the QUAM ION TRAP, also utilizing permanent magnets, makes it preferred equipment for better television receivers.

QUAM-NICHOLS CO. 33rd Place and Cottage Grove
Makers of QUAM Adjust-A-Cone SPEAKERS

it provides a permanent transmission line which is highly stable both electrically and mechanically.

For best results, the cable should be maintained under gas pressure at all times. Suitable gas-tight end terminals and other appropriate fittings are available. Upon request the cable will be shipped under pressure.

Bulletin 29-A gives full details on the cable and accessories. A copy is available on request.

RELAY ENCLOSURE

A new dust-tight, plug-in enclosure for the small *Clare* Type "J" relay is now being offered by C. P. Clare &



Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois.

Entrance of dust is prevented by the steel cover and by the use of a Neoprene gasket which is closely fitted to the relay terminals at the factory.

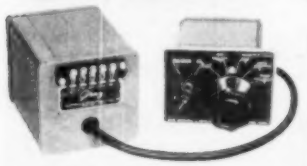
Installation is facilitated by use of a standard radio-type plug, which also reduces wiring costs. The base is secured to the chassis to prevent plug from being jarred or accidentally pulled from its socket. The dust-tight cover is easily removable for inspection.

A bulletin, No. 108, covers the new enclosure and is available on direct request to the company.

GRAY EQUALIZER

The Gray Research & Development Co., Inc. of Hartford 1, Conn., has announced the addition of the Model 603 to its line of equalizers. The new unit is said to provide a greater range of response curves and additional compensation to accommodate pickups of different characteristics than did previous models.

The high-frequency characteristic obtainable with the Model 603 com-



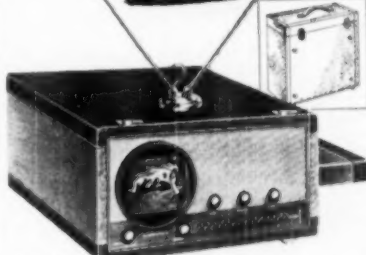
prise five steps ranging from flat response to a heavy roll-off for worn records. An auxiliary knob permits instant adaptation to the use of either

March, 1950

SAVE \$30!

7-IN. PORTABLE TELEVISION SET
REGULAR \$119.50 VALUE

\$89.97



WE AGREED NOT TO MENTION THE NAME—BUT WE GUARANTEE YOU'LL BE PLEASED!

- You can get 10-in. picture with this set, order Glenwood unbreakable enlarging lens (our stock No. 35B33) at only \$8.79.
- Get maximum low cost TV enjoyment.

The ideal all-purpose television receiver. Carries easily from place to place, operates from its own antenna—no connections required except plugging in power cord. Antenna is adjustable for length and direction for maximum picture brightness. Brings in crystal clear pictures even under variable conditions of lighting and signal strength.

16 Tubes plus Picture Tube and 4 Rectifiers, 23 sq. in. rectangular picture on face of the 7-inch tube. Push-button tuning

provides instant station selection on any of the 12 tuning channels. Sturdy wood cabinet covered with tan leatherette. Cover with carrying handle hinges and snaps to side of set, fully protecting picture tube and controls. Matched antenna extends from top of cabinet. Size overall 20 in. wide, 10 1/2 in. high by 18 1/2 in. deep. Shpg. wt. approx. 53 lbs. For 105-125 volt 60 cycle AC only. No. 39A20

EACH **\$89.97**

\$49.95

REG. LIST PRICE \$89.95

IT'S A RECORDER, A RADIO AND A PHONOGRAPH



THE WILCOX-GAY Recordette

- The Recordette is compact in design, and easily portable, weighing less than 18 lbs.
- Has four-position switch, "Listen-Phono", "Listen-Radio", "Record-Radio", "Record-Mike"—plus volume level indicator.

A real "Triple-Threat" disc recorder that makes recordings from microphone or from its own radio, plays phonograph records, and contains an excellent superheterodyne receiver. Uses only one tone arm for both cutting and playback, making this unit exceptionally easy to operate. Cuts and plays records up to 12".

Constant-speed 78 RPM motor is four pole recording type. Has 10" turntable with rim drive. AC superhet

chassis has low impedance loop antenna. Quality PM speaker, Crystal pickup and recording cartridge. Crystal microphone is carried in special holder on inside cover. Tan-and-brown leatherette-covered case, 18 x 12 1/2 x 6". With tubes, mike, cutting needle, pack of steel playback needles. For 110-120 volts, 60 cycles AC. Shpg. wt. 20 lbs.

No. 31B229 **\$49.95**
SPECIAL EACH

Prices FOB Kansas City. Remit with order or send 25% deposit when COD.



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Also available—FWCT-3 PH—Write for prices

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60 Amp.—SPST—Cr. 2500-K682	Each	\$0.95
30 Amp.—DPST—Cr. 2500-K682	Each	.50
15 Amp.—DPST—Momentary—C-B	Each	.50
15 Amp.—SPST—Momentary—B-21	Each	.35

Standard Transformers—Power & Fil. 60 mil. \$1.75; 100 mil. 1.25; 150 mil. 1.00; 200 mil. .90. Also—2500-K682—100-550V. Very special, each. American Quartz Carbon Mike Xmm—shielded—each—\$1.00.

FREQUENCY MARKER BASIC KIT

100Kc Xtal and Matching shielded non-inductive plate tank. \$2.95

24V. CT. 1 AMP. FILA. XFORMER—\$1.95

Small—New P.H. Surplus Extension, Each

F.O.B. N.Y. Based firms, 10 days. Quantities discounts.

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5 Volt 15 amp. Transformer, Baled, 110-220 V. Pri. Fully Cased.	\$1.79
.001 600 VDC Pictal Mica.	20 for .99
.004 1000 VDC Pictal Mica.	12 for .99
250 mmf Midgel Variable, Statite Inc.	2 for .86
325 mmf Midgel Variable, Statite Inc.	2 for .86
1 meg Potentiometer.	23 ea. 5 for .95
50,000 ohm 1% WW Preci. Resist.	19 ea. 6 for .95
6 Henry 50 ma Filter Chokes.	4 for .95
2" GE Meter 0-1 ma. (amp scale).	ea. 1.79
2" GE Meter 0-10 amps AC.	ea. 1.79
3" Triplett Meter 0-75 amps AC.	ea. 1.99
.01 1000 VDC Xmitting Mica.	1 for .99
.02 600 VDC Xmitting Mica.	6 for .99
.001 600 VDC Xmitting Mica.	10 for .99
1.3 mfd 600 VDC Oil Condenser.	ea. .49
6 mfd 1000 VDC Oil Condenser.	ea. .89
1 mfd 7500 VDC Oil Condenser.	ea. .89
15 mfd at 10 KV plus 7 mfd 8 KV.	ea. 3.95
1 x 1 x 1 mfd 1200 VDC.	ea. .49
100 ohm 100 Watt Adjustable Resistor.	ea. .39
500 ohm 50 Watt Adjustable Resistor.	ea. .29
1, 5 or 10 ohm 25 Watt Adjustable Resistor.	ea. .19
.02 500 Volt Tubulars.	20 for .99
10 K or 15 K pots.	ea. 2 for .99
.0005 mfd Pictal Silver Micas.	10 for .95
.006 mfd 600 VDC Pictal Micas.	12 for .99
.01 mfd 600 VDC Pictal Micas.	ea. 1.99
2 mfd 250 VAC GE.	8 for .99
Miniature Headphones Type HB30.	ea. .59
Transformers for other sizes.	ea. .39
3" Westinghouse Meter 0-20 ma.	2.79

PANEL METERS—BRAND NEW

2" 0-1 ma Basic.	\$2.95
2" 0-20 ma Basic.	1.75
2" 0-1 amp R.F.	2.45
2" 0-10 V. AC.	2.50
2" 0-30 V. DC.	2.50
2" 0-100 V. AC.	2.95
2" 0-300 V. AC.	2.95
3" Square Weston.	3" 0-200 ma DC.
0-200 micro amp	0.75
1" 0-20 ma DC.	3.50

HIGH CURRENT TRANSF. 820 Volts CT at 775 Ma. Pri. 110-220 Volts 60 cycles. Fully Cased. \$9.95

RELAY SPECIALS

Advance Antenna Relay 110V 60 Cy Coil Ceramic Insulation, DPST.	\$1.80
Busco Relay 6 Volt 60 Cy Ctd. Ceramic Insulation, DPST.	1.40
Allen Bradley Schenck, 110V 60 Cy Ctd. DPST.	2.95
25 amp electrically.	
Westinghouse "MN" Overload Relay, adjustable	4.95
250 Ma. 1 amp. overload relay.	
GE "FPH" Instantaneous overload relay adj.	7.95
100-700 Ma. Elect. reset 110V 60 Cy.	4.95
GE overload relay 640 Ma. easily made adjustable, reset 110V 60 Cy.	2.50
UTC type PA 5000 ohm plate to 500 ohm line and 6 ohm voice coil. 10 watt. 60 to 10,000 cps.	1.00
DB.	CLOSE OUT AT \$1.99

FILAMENT TRANSFORMERS

110 V 60 Cy P. Fully Cased.	
2.5 Volt 10 Amp.	\$1.49
2.5 Volt CT 21 Amp.	4.75
6.3 Volt 10 Amp.	1.69
5 1/2 V CT 21A, 7.5V 6A, 7.5V 6A.	4.95
5 Volt 1A, 5.3V 3A.	2.45
2.5V CT 20A, 2.5V CT 20A.	6.80

OIL CONDENSERS

20 mfd 330 vac—\$1.85	8 mfd 2000 vdc—\$5.95
1 mfd 600 vdc—2.75	10 mfd 2000 vdc—5.95
2 mfd 600 vdc—3.25	2 mfd 1000 vdc—2.50
4 mfd 600 vdc—3.95	1 mfd 5000 vdc—4.50
4 mfd 600 vdc—3.95	1 mfd 1000 vdc—2.25
8 mfd 600 vdc—1.39	1 mfd 7500 vdc—3.25
10 mfd 600 vdc—89	01-.01 mfd 12 kv—5.75
20 mfd 600 vdc—2.15	1 mfd 1000 vdc—35
4 mfd 1000 vdc—35	005.01 mfd 12KV—5.50
2 mfd 1500 vdc—1.25	
4 mfd 1500 vdc—2.25	65 mfd 12,500 vdc—12.95
6 mfd 1500 vdc—2.95	
2 mfd 2000 vdc—1.45	2 mfd 18 kv dc—\$9.50
2 mfd 2000 vdc—2.25	1 mfd 15 kv dc—12.50

CHOKES BARGAINS

6 Henry 80 ma 220 ohms.	2 for \$6.99
6 Henry 150 ma 110 ohms.	ea. .99
1.5 Henry 250 ma 75 ohms.	ea. .59
6 Henry 300 ma 65 ohms.	ea. 3.75
Swing, 1.5-12 Hy 1 Amp 100 ma 15 ohm.	19.95

SCOPE TRANSFORMERS

Pri 110V Cy—Hermetically Sealed	
3500V RMS @ 12 MA.	\$2.95
1050V RMS @ 20 MA, 20V 4.5A, 2.5V 5A.	4.75
1400V RMS @ 10 MA, 1A, 15KV line.	4.95

GENERAL PURPOSE TRANSFORMERS

Ideal for Bias, Filament, Standby, etc.	
2 isolated 110v or sec, 110v at 900 ma plus 6.3	ea. 2 amps. Fully cased. Now \$1.49 ea.

30 WATT WIRE WOUND RESISTORS

UMS 100-150-2500-3k-4k-4500-5k-5000-10k, 12k-18k.	15 ea. 6 for \$0.99
Elmac Vacuum Condenser 50 mmf 32 KV Type VC50-32	ea. \$3.95

MEG OHM METER

Industrial Instruments model L2AU 110-220 volts 60 cycle input. Direct reading from 0-10,000 megohms on 4 meg scale can be extended to 50,000 megohms with external supply. Blowing hardwood Cabinet 15" x 8" x 10". Brand new with tubes plus running spare dark including extra tubes. Res. price \$100.00.

OUR PRICE

\$49.95

PEAK ELECTRONICS CO.

188 WASHINGTON STREET DEPT. MR
NEW YORK 7, N. Y.

the Pickering cartridge or the General Electric variable reluctance pickup, for which correct compensations are provided. In all cases exceptionally close adherence to the correct characteristics is obtained.

A selection of 150 or 250 ohms impedance can be made by making appropriate connections to the equalizer terminal board. The controls are mounted on a clearly marked panel which is connected to the equalizer by means of an 18 inch shielded cable.

TWO-WAY SPEAKER SYSTEM

Holl Audio Industries of Hollywood 28, California, has recently added the Model 800 F, low distortion, two-way loudspeaker to its line of audio equipment.

Among the features of this new unit is the special plastic treatment of the cone compliance to improve edge dampening and reduce distortion caused by cone breakup, the reduction of cone resonance and cabinet "boom," the elimination of the usual 60-90 cycle bass reflex boom, correct matching of the highs and lows, thus eliminating the need for pads on the high



section, and a full frequency range from 40 to 15,000 cycles.

The loudspeaker is housed in a furniture-finish cabinet which measures 37 1/2" high by 25 1/2" wide by 16" deep. Bass reinforcement is by the vented tube method. Acoustical padding is used on all interior walls. The multicellular high-frequency horn is driven by an Alnico V PM driver. The woofer section has a 15", 25 watt loudspeaker with 25 ounce Alnico V magnet. The free air resonance of the cone is 40-45 c.p.s. The 800 cycle crossover has air core windings and meets theater standards.

DYNAMIC MICROPHONE

A new dynamic microphone, the TV 655, has been announced by Electro-Voice, Inc. of Buchanan, Michigan.

This slim, versatile microphone with ultra-wide range and high fidelity dynamic performance and utility, requires no additional closely-associated auxiliary equipment.

Engineered and built to meet the need in studio and remote telecasting and broadcasting, the new TV 655 is suitable for special events announcing, sportscasting, audience partici-

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NEW

MODEL 431A MULTITESTER

AC AND DC VOLTS
0-15 / 30 / 150 / 300 / 1500 / 3000
DC CURRENT
0-1/5 / 150 mds. 0-750 Ampe.
Ohms Full Scale: 0-10,000/100,000/1 Meg
Ohms Center Scale: 0-60 / 600 / 6,000
Drawn Aluminum Case: 6 1/2" x 3 1/2" x 2 1/2"

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SAVE MONEY BRAND NEW GUARANTEED GENERAL ELECTRIC SELSYN

Type 2J1G1

Will operate from 110 volts, 60 cycle by using a resistor or a condenser in series. Size is 2 1/2" in diameter x 6 1/2" long. Ideal for beam antenna position indicator.

Price \$2.75 per pair — removed from new equipment



HAYDEN TIMING MOTORS

Type 45629R

110 volts, 60 cycle, 2.2 watts, 1/240 R.P.M.

Price \$3.00 ea. net, now

Type 36938-2

110 volts, 60 cycle, 2.3 watts, 1/2 R.P.M.

Price \$3.00 ea. net, now

Type 33669-2

110 volts, 60 cycle, 2 watt, 1/2 R.P.M.

Price \$3.00 ea. net, now

Type 1600

110 volts, 60 cycle, 2.3 watts, 1 R.P.M.

Price \$2.70 ea. net, now

NEW ADDRESS
INSTRUMENT ASSOCIATES
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GREAT NECK, N. Y.
Imperial 7-1147

pation, recording, and high quality sound amplification. It can be used either on a stand or in the hand or on a boom. It does not hide the performer's face and can be easily concealed among studio props.

This model is omni-directional, becoming slightly directional at extremely high frequencies. It provides smooth, peak-free response over the range of 40 to 15,000 c.p.s., plus or minus 2.5 db., according to the company.

A bulletin giving specifications and operational characteristics of the TV 655 is available on request. Ask for TV Bulletin No. 156.

NEW V.T.V.M. KIT

Heath Company of Benton Harbor, Michigan, has placed a new v.t.v.m. kit on the market, the V-4.

Positive automatic meter protec-



tion on all functions is given by the electronic a.c. voltmeter and push-pull d.c. voltmeter circuit. The electronic a.c. voltmeter circuit incorporates a new balance control which allows complete elimination of contact potential, removes meter shift with various ranges, and gives accurate readings on all ranges. The 200 microampere meter uses an Alnico V magnet for accurate readings. The divider resistors are 1% precision ceramic units. The unit provides 24 complete ranges. The meter pointer can be offset from zero for FM and TV alignment. The d.c. probe is isolated for dynamic measurements of receiver voltages without disturbing receiver operation.

MIDGET ELECTROLYTICS

A line of small paper tubular condensers, known as Type P85, is now available from Aerovox Corporation of New Bedford, Massachusetts.

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March, 1950

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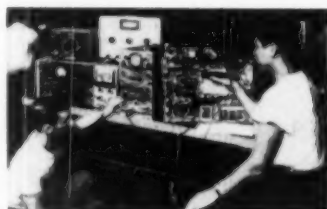
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International Short-Wave

(Continued from page 59)

for listeners in Eritrea. ETB has been heard widely in the United States around 1000-1100 weekdays and on Sundays from as early as 0930; on Sundays, several religious programs are radiated, some of which are in English. Schedule seems irregular, signals are poor, badly QRM'd.

Formosa—Sanderson, Australia, still lists BCAF, 8.995, heard 0530 with Chinese program; English lesson 0700.

France—Paris is now using 9.550, 9.680 to North America 1945-2000 in English.

A frequency of 15.1000 is being used by Paris at 0630-0645; 6.145 is used 0030-0045, 0130-0145, 1300-1445. (Bluman, Israel)

French Indo-China—Station officials have informed Bellington, N. Y., that the name of *Radio Saigon* has been changed to "*Radio France Asie*," since it is now a Vietnamese outlet. Schedules for the most part remain unchanged.

French West Africa—*Radio Bamako* advises it has an output of 2 kw, on 15.030; the station is operated by the government and is on the air at irregular intervals. Programs consist of meteorological forecasts, government, and industrial news, and now and then some music. (The Broadcaster, Perth, Western Australia) FGJ9, Bamako, is listed on 15.025 with 350 watts and as "inactive."

Germany—Patrick, England, reports that some time ago he logged a station on approximately 5.880 around 1200 relaying AFN programs from Munich's m.w. station.

Radio Frankfurt, 6.190, has a good signal around 0130. (Bluman, Israel)

Greece—The Armed Forces in Central Greece, outlet at Larissa, has moved to approximately 6.770 from 6.745, but still has bad CWQRM; is heard afternoons.

Holland—Latest schedules for *Radio Nederland's International Service* are: English—0500-0555 to Australia (Continued on page 140)

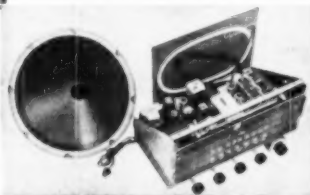
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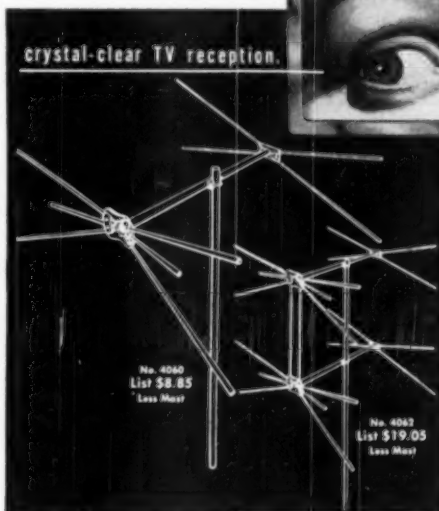
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MANUFACTURING COMPANY, INC.

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March, 1950

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Ulan-Bator-Choto in Soviet-Mongolia daily on 8.400 to around 1000.

Mozambique—Laubscher, South Africa, lists new schedule of English broadcasts from Lourenco Marques as CR7BE, 9.715 (claimed by station, actually appears to be 9.763), 0000-1100; CR7BU, 4.932, 1000-1600; CR7AA, 6.137, 0000-1000; and CR7AB, 3.493, 1100-1600; on Sundays, CR7BE and CR7AA begin 0200.

Nigeria—A station reported on 9.655 by Simpson, Australia, and Cushen, N. Z., relaying BBC's General Overseas Service around 0200 is believed to announce "This is Nigeria." (Radio Australia)

Pakistan—Recently, Pakistan outlets have been moving about a great deal. At the time this was compiled, Karachi seemed to be using 11.770.5 with Dacca, approximately 7.635, in parallel, for news 0700 and 1015; the 15.335 outlet, formerly Dacca, was being heard with news 2100, but Karachi, 11.885, seemed to not be in use; the 15.335 channel at 2115 was announcing as "in the Home Service of Radio Karachi," so may be Karachi moved from 11.885 instead of actually being Dacca, as formerly. Karachi has been reported testing on 15.15 and on 9.645, irregularly. A station on approximately 11.81, which has been QRM'g VLT7, 11.81, in the East Coast beam from Radio Australia around 0700-0830 or later, is believed to be a Pakistan outlet.

Panama—HP5K, 6.005, Colon, noted 0600-0630 in English. (Hefner, D. C.)

Philippines—The new Philippine station on approximately 4.985 has been identified by Cushen, N. Z., as DYB2, relaying medium-wave DYBR; it announces "This is Davao," so is assumed to be at Davao, Mindanao; schedule was given as 0500-0900. (Radio Australia) Heard in Australia at 0630 with musical program and news. DZH4, 6.000, heard 0645 with sponsored program of music and news. DZH7, 9.748, noted 0500 with news, then music. DZH3, 9.505, noted 0530 with sponsored program of music.

Poland—Warsaw, 9.527, noted 0200 with Polish news, then music. (Sanderson, Australia)

Portugal—Mesquita e Sousa, Portugal, says Radio Clube Portugues at Parede is now CSB51, instead of CS2W1.

Sao Tome—CR5SA, "Radio Clube de Sao Tome," 9.615, has been heard by DeMyer, Mich., signing on 1445 with nice signal; all-Portuguese; is buried in QRM from 1500.

Saudi Arabia—Bluman, Israel, says regular schedule of Mecca is now 1200-1300 on 3.960, 5.985, 9.645, and 11.950. (Radio Australia)

South Africa—Laubscher, South Africa, reports that as of May 1, the South African Broadcasting Corporation will begin its commercial program in the Transvaal; other provinces will follow later with commercial programs; the new service will be known as "Springbok Radio" and will use s.w. frequencies in the 31-, 40-, 60-, 90-, and

March, 1950



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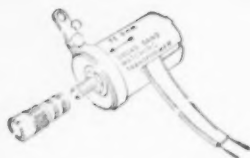


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142

120-meter bands; specific frequencies have not yet been given. Schedules will be 2345-1600. By that time it is expected that regular SABC schedules will most likely be the same, doing away with the "mid-morning" and "mid-afternoon" (in South Africa) breaks as at present.

Southern Rhodesia—Laubscher, South Africa, says, according to press dispatches, a new transmitter of 15 kw. should be in operation from Salisbury by this time. While no frequency was listed, it will most likely be 3.320 which Laubscher heard testing some months ago. Plans have been made to extend schedules in both Northern and Southern Rhodesia soon.

Spain—Radio Nacional de Espana, Madrid, Spain, is now issuing a monthly program leaflet in English, free of charge. (Sklenar, Nebraska, others)

Sweden—Radio Sweden is sending out a new, all-English verification card. (Skoog, Sweden) A sample sent me is quite attractive.

Syria—Damascus has been testing on 5.000 to 5.005 in parallel with 6.000, 11.750, according to Bluman, Israel; news 0530, 1400. (Radio Australia)

Tahiti—A phone station at Papeete that might possibly come into broadcast use has been heard by Balbi, Calif., with fine signal on 9.035, around 0300-0430, calling Paris.

Tangiers—The new "Voice of America" relay station (Tangier I) is widely reported heard with fine signals afternoons to 1730 closedown.

Thailand—Bangkok appears to have replaced 6.010 with 6.240 in parallel with approximately 9.796 for the overseas transmission at 0500-0630 and for the native program at 0700-1030. Now announces as "The Overseas Broadcasting Station of Thailand."

USA—It is widely reported that WWV now announces in voice at 5-minute intervals, giving the time.

USSR—Petrovavlosk, 6.075, has dropped its 0123-0230 transmission. (Balbi, Calif.)

Vatican—Peddle, Newfoundland, reports HVJ on 7.280 at 1515 in Czech. Is heard in England on 7.28 around 1500 in parallel with approximately 9.643, 5.970, according to Pearce.

Last Minute Flashes

At press time I received a flash from Dilg, Calif., that he had picked up a strong signal on approximately 6.095 to 6.100 around 1050; played western orchestral music; had numerous breaks but the same type of music continued to after 1200; no announcements 1130 or 1200; signal unusually good for 49 meters that late; evidently was a test of some kind but Dilg did not know from where; from strength must have been at least a 100 kw. transmitter, he said.

Starry, Pa., reports good signal from Johannesburg, 9.523, around 0100-0200.

Radio Douala, Cameroons, sent verification letter in 17 days; listed frequency of 9.150, said using 600 watts with Delta antenna oriented NW-SE; said will have a new 1 kw. transmitter

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14-ft. Tower (Two 12-ft. Sections).....	28.50
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48-ft. Tower (Four 12-ft. Sections).....	02.50

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RADIO & TELEVISION NEWS

ready in 1950 and will then use 7.278; wants reports. (Starry, Pa.)

Paris-Inter, 6.200, 100 kw., is a strong signal in Norway with its Light Program weekdays 0515-0830, 1400-1815; Sundays 0130-1815. (Halvorsen)

I recently heard a Chinese station on approximately 6.100 carrying the 0830 news from Peking; good signal; possibly Chungking?

Radio Pakistan has been heard on 9.645 with news 1015. (Balbi, Calif., Fried, Mich.)

Cebu, Philippines, 6.140, heard in Texas 0830 in English. (Stark)

Pearce, England, reports Radio International, Tangiers, on 6.110 at 1700 with program in Spanish.

The Chinese Communist outlet around 6.650 does not take the Peking network program either before or after 0830. (Balbi, Dilg, Calif.)

Ponta Delgada, Azores, CS9MB, 4.845, is good level in Norway 1700-1900, reports Halvorsen. The same monitor reports the Blue Danube Network, Salzburg, Austria, is now scheduled weekdays 0000-1800, Sundays 0100-1800; that Dornbirn, French Zone, is scheduled 0000-0300, 0500-0810, 1000-1800; Salzburg operates on 9.533, Dornbirn on 6.000.

Port-au-Prince, Haiti, 4VRW, at the time this was compiled had moved from 9.785 to 10.200. (Balbi, Calif.)

Radio Ceylon, 15.12, heard around 1335-1425 calling AIR with news dispatches, talks. (Fargo, Ga.)

Dilg, Calif., flashed that Rangoon seemed to have moved from 6.035 to around 6.070-6.075, heard signing off 1015, Balbi, Calif., flashed that BED2, 11.725, Taipei, Formosa, had replaced the 15.235 channel 2300-0100.

Radio Pakistan at Karachi has been heard on 17.835 at 0110 in parallel with 11.885; heard reopening 0700 on 17.770 and 11.810 as well as on 11.770 which is quite noisy; transmission closes 0830, but comes on again 0900 on 9.645 and 11.770. The "Voice of Free China" at Taipei, Formosa, has moved to the 41-meter band, approximately 7.260, where has news 0610, and identifies as BED2, BED4, and BED7. A station heard a recent Saturday at 0620 on measured 18.406 with news identified as "The Voice of the Viet Nam" and is assumed to be operating from French Indo-China. Australian DX-ers report Bangkok is now heard on 15.910 in parallel with 6.240 at 0500; they list call for 15.910 as HSJ4. DZHT, 9.740, Manila, will soon increase power from 300 watts to 3 kw. and will beam in the direction of Bombay; wants reports to The Far Eastern Broadcasting Company, P.O. Box 2041, Manila, Philippines. (Radio Australia)

On the day this went to press, HVJ, Vatican City, was an excellent signal here in West Virginia in its (daily) 1315 English period.

Acknowledgement

Many thanks, fellows, for the extremely good cooperation, especially with regard to data for the English newscast list. KRB.

March, 1950

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1F4	3Q4	6BA7	6K7GT	12AGT	12BG7	30	77
1R5	3V4	6BE6	6SO7GT	12A6	12J7GT	15B5	117Z3
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20/20		450	.50
50		350	.30
80/10/10/20		250/250/250/25	.20
40/20		150/150/150	.40
100/10/10		150/150/150	.40
30/30/100/100		150/150/25/25	.40
40/10/20/200		150/150/50/10	.40
20/20/20		50/50/50	.20
2000		15	.20

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413	425	438	442	454	496	512	525
414	426	440	448	465	497	515	522
415	427	441	477	487	498	516	523
416	429	447	473	488	503		
418	431	443	474	490	504		
419	433	444	475	491	506		
420	434	445	477	492	507		
422	435	446	479	493	508		
423	436	447	481	494	509		

each
10 for 14.50

377	376	379	381	384	387
374	377	380	383	386	388

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790	791	796	801	804	809
791	794	797	802	805	811
792	795	800	803	806	

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450	464	475	579	585	593	599
452	477	485	577	580	585	586
461	471	576	588	591	594	597

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5030	6075	6206	6940	7973	7975
5405	6100	6208	6273	7986	8280
6006	6106	6273	7140	7925	8273
6075	6140	6840	7173	7950	8306
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5805	5773	5906	6425	6640	7440	8073	
5875	5775	5925	6440	6673	7473		
5977	5806	5940	6450	6706	7486		
5700	5825	5973	6473	6740	7490		
5796	5840	5975	6475	6750	7513		
5775	5950	6273	6506	7386			
5740	5873	6340	6540	7380			
5740	5875	6373	6573	7373			

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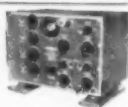
7045	7290	7380	7425	8000	7510	7945	7995
7345	7250	7320	7442	7575	7670	7955	
7125	7260	7360	7540	7675	7950		
7145	7282	7380	7545	7680	7970		
7155	7280	7475	7557	7672	7940		

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TV Interference Patterns (Continued from page 49)

ting into the video circuit. The frequency of the audio signal determines the number of bars obtained. The higher the frequency, the greater the number of bars.

Now adjust the signal generator to deliver an unmodulated r.f. signal—the frequency is not too important, but should be somewhere between 100 kc. and 1 or 2 megacycles.

In this case, the frequency of the signal is greater than line sweep frequency, so that the individual lines will be made brighter and darker along their length. This may result in the vertical line pattern shown in Fig. 1B. The lines may not only be vertical, but may slant either to the right or left, as shown in Fig. 1C.

Whether the lines are perfectly vertical, or slant to one side, as well as the number of lines seen, all depend on the frequency of the interfering signal with respect to line frequency (15,750 c.p.s.). This can be readily demonstrated by varying the frequency of the signal generator over a fairly broad range. At some frequency settings the line pattern will not be obtained, but a very coarse "grain" effect will be seen.

This type of interference pattern (vertical and slanting lines) may be caused by interference from a strong r.f. carrier signal, whether a ham station, broadcast station, or other source. It is quite a distinctive pattern and easily recognized once seen in its different forms.

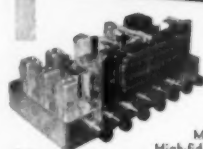
To demonstrate the type of interference pattern caused by an AM modulated r.f. signal, simply switch the signal generator to deliver a modulated r.f. output. The vertical lines will still be seen, but horizontal bars will also be present. The modulated r.f. signal may, at certain frequencies, form a "checkerboard" pattern.

If the signal generator is tuned to deliver an r.f. signal with a frequency of 4.5 mc., then a very fine grain-like pattern may be seen on the screen. This is the same type of pattern obtained when there is a strong beat between the video and audio carriers due to misalignment of the video i.f. stages, misadjustments of traps, or due to turning the contrast control too high in high definition sets.

Since fine lines which may be perfectly vertical, or which may slant either to the right or left are obtained with different frequency r.f. signals, we might expect FM interference to give us a combination of changing lines . . . lines which slant first one way, then another, and which vary in number. If the frequency variation is smooth and does not occur in jumps, then the line variation must be smooth, and the effect of a "wavy line" pattern might be expected.

And this is exactly the type of pattern that is obtained due to FM inter-

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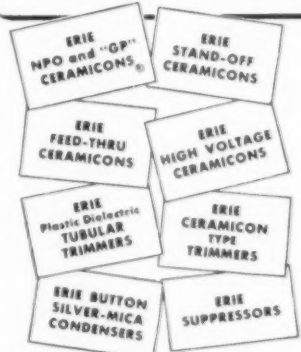
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RADIO & TELEVISION NEWS

ference, whether from an FM station or from a piece of r.f. equipment whose frequency varies rapidly under load (such as diathermy equipment). The basic pattern can be demonstrated by manually shifting the signal generator frequency rapidly back and forth over a small range, and watching the screen of the TV set. The type of pattern obtained, typical of FM interference patterns, is shown in Fig. 1D.

The general technique of demonstrating television interference patterns as described is not only of value to the service technician trying to gain experience in TV, but may also be used to good advantage in schools, where some of the interference conditions encountered are discussed. An actual demonstration of the type of pattern obtained in a particular case of interference enables the student to get a much clearer picture than the longest lecture type description, or the best photographic reproduction.

-30-

Broadband Converters

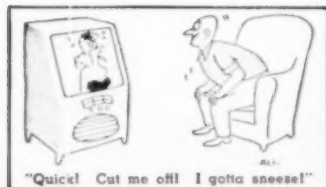
(Continued from page 40)

nal boosters, etc. It should have its variable condenser, a mica padder, open to about half its capacity when the r.f. and oscillator circuits are tuned, and then adjusted for maximum signal. Its adjustment may require a slight touching up of the r.f. coil tuning in order to repeat the output signal.

The photographs of the dual 6AG5 converter may make it appear more complicated than it is. This is because equipment not required for converter operation was mounted in the same box. A break-in relay and antenna switch were added for transmitter operation. The antenna switch can be of the double-pole, miniature type where a transmitter is not to be used in conjunction with the converter. Here it is used for antenna switching, converter and transmitter filament switch, and as a safety to keep the transmitter high voltage from being applied until filament voltage is applied. A triple-pole, double-throw switch is needed in this case. The break-in relay may be applied to any converter so that it removes screen grid or oscillator voltage from the TB-17 (war surplus) carbon mike button when pushed for transmission.

A break-in relay is not a "must," it simply removes the need for turning down the receiver gain each transmission and decreases the recovery time of the receiver by keeping it from becoming blocked.

-30-



March, 1950

MICROPHONES	AMPLIFIERS	SPEAKERS	SPEAKER HOUSINGS
<ul style="list-style-type: none"> Pressure Velocity Cardioid Variacoustic Hand Sets Sound Power Telephones Stands, Plugs, Cables and Connectors 	<ul style="list-style-type: none"> Pre-Amplifiers Line Amplifiers Voltage Amplifiers Power Amplifiers Remote Amplifiers 	<ul style="list-style-type: none"> Cone Type Horns and Drivers High-Fidelity Speakers Speaker Accessories 	<ul style="list-style-type: none"> Buffers, All Types Console Cabinets
INTERCOM SYSTEMS <ul style="list-style-type: none"> All Master Systems Master-Remote Systems Combination Systems 			PORTABLE SOUND SYSTEMS
CUSTOM-BUILT EQUIPMENT <ul style="list-style-type: none"> Consoles Desks Turrets Cabinets 			PROGRAM CONTROL UNITS <ul style="list-style-type: none"> Single Channel Dual Channel Custom-Built

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National



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Condenser Tester

(Continued from page 48)

condenser is larger than 90 μ fd., other means must be employed to determine its capacity.

One other adjustment which is necessary is the initial tuning. This is accomplished by a third variable condenser connected across the tuned circuit. The calibrated condenser is set to zero on the dial and this last condenser adjusted to give zero beat in the detector. When the unknown is connected, the calibrated condenser is then returned to give zero beat. Sometimes zero beat is not a desirable reference point. In this case, some pitch such as 500 cycles can be used, but a special caution is then necessary. There are two adjustments which will give this beat, one either side of zero beat. If the initial adjustment is on the high-frequency side of zero beat, the final tuning must also be on the high side, otherwise, a large error will result.

The detector is of the oscillating type. That is, enough of the output is returned in the proper phase to the input so that the circuit oscillates. This makes it possible to have an audio beat note between the incoming signal and the self oscillations of the detector. The output of the detector which consists of the audio beat frequency plus the two radio-frequency currents which produce the beat is sent through a filter which eliminates all but the audio beat and passes this to an audio amplifier.

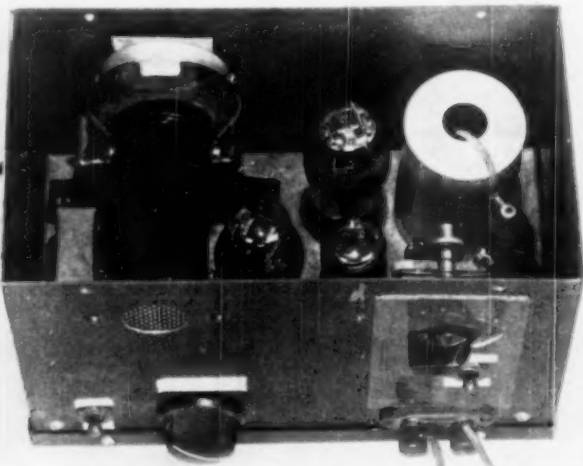
The foregoing paragraphs explain the basic principles of the instrument. A few refinements were embodied in the unit which were dictated by necessity. First of these was in the main oscillator. In order to obtain the

necessary stability of frequency, an oscillator having a fundamental frequency of 80 kc. was used. On the other hand, the detector was adjusted to 560 kc., the seventh harmonic of the oscillator fundamental. This brings about two advantages. First, the frequency change of the oscillator is multiplied sevenfold so that the observer has no difficulty detecting the change. Second, the frequencies of the two circuits are independent of adjustment of each other. Were the oscillator and detector on the same frequency, they would tend to "pull" each other into zero beat. All the audio amplification that is required is a single beam pentode amplifier. This provides ample output.

The accompanying diagram shows the complete circuit of the unit. C_1 is the calibrated tuning condenser; C_2 is the semi-adjustable condenser which may be removed from the circuit when capacities greater than 45 μ fd. are being measured; C_3 is the initial adjustment condenser. C_4 is actually connected across the detector circuit instead of the oscillator. This was done in order to reduce the components in the oscillator tuned circuit. Since the detector needs a tuning condenser anyway, it was found that greater stability results through this arrangement.

One additional feature which is of interest is incorporated in the audio output circuit. It is necessary to have a reference audio frequency for the initial and final adjustments. An ordinary earphone was tested and found to have a natural resonant frequency of about 800 cycles. This was fastened to a 1.5 inch diameter tube whose length was adjusted to have the same resonant frequency. When the proper audio frequency, 800 cycles, is obtained, the audio output is stronger than at any other frequency.

Top view of the completed condenser tester with the cover removed to show parts layout.



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Behind the Scenes

(Continued from page 41)

rect focus is achieved by movement of the tube—the image orthon—while the lens remains stationary.

NBC cameramen are trained according to good motion picture standards, since the composition of the picture is of prime importance. The cameraman's function throughout the performance is to select the proper lens and align optically for best composition. He is in constant communication with the technical director in the control room through a direct phone line, and he wears an ear-plug receiver, specially designed by NBC engineers.

Boom man—microphones: The standard adjustable motion picture type of microphone boom is used in a television studio. The microphone is suspended from this boom and its characteristics are unidirectional. This is preferable because of its back sound-rejection qualities. The boom man must manipulate his controls so that the microphone follows the actor as he moves from one place to another during the performance. The boom man receives his instructions from the audio engineer in the control room through a headphone.

Light direction man—lights: The lighting of the show comes under the supervision of the light direction man and two or three assistants.

A highly flexible and controlled incandescent lighting system is used most. Spotlights are used for modeling effects, broad (or flood) lights are utilized for filler light and general key illumination. This is similar to units utilized in standard motion picture lighting practice.

Stage Manager: This man—in the studio—is the visible representative of the program director, and he indicates to the performers the wishes of the director in reference to cues, positions, speeding or slowing of action, and so on. Since the stage manager is constantly on the move around the studio, he would be hampered if he had to use standard phone connections for communications from the director. He is, therefore, equipped with a small radio receiver, called a "pocket ear," over which the director actually broadcasts to him. The power used in this transmission is only sufficient to reach the stage manager . . . it cannot project outside the confines of studio.

The men who control the activities of these technicians operating in the studio are located in the control room.

In the Control Room

Program Director: He is in charge of the entire operation, and is guided by physical and technical limitations as interpreted by his technical director working beside him. It is the program director who, during rehearsals, has set the action of the program, and has determined the actual shots and angles

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NATIONAL CONVENTION

For the second time in four years, part of the AFCA annual convention will be held at the Signal Corps Center, Fort Monmouth, on May 13th. The first day of the meeting, May 12th, will be spent in New York City and will be devoted to business meetings, conferences, and the annual banquet, plus a visit to the Photographic Center in Astoria, L. I.

Delegates will arrive at Fort Monmouth as guests of Maj. Gen. F. H. Lanahan, Jr., commanding general, and AFCA's Fort Monmouth Chapter to take part in a full-day program, during which they will be addressed by Maj. Gen. Spencer B. Akin, Chief Signal Officer, and other dignitaries.

The tentative itinerary will include outdoor and indoor exhibits, a tour of the Signal Corps Engineering Laboratories, other post activities, and luncheon with Signal Corps troops in the field.

During the afternoon, the visitors are scheduled to witness a combat problem, high speed wire laying, and other demonstrations, followed by a review of troops during which Signal Corps participation in the Civil, Spanish, and both World Wars will be symbolized.

The exhibits and demonstrations being planned will include television, radar, radio relay, high frequency equipment and others that will present the Army's progress in electronic and communications fields.

AFCA CHAPTER NOTES

Atlanta

The part that photography has played in the production of visual education aids at Camp Gordon's two

Army technical training schools was discussed by Capt. Roger L. Leonard, Signal Corps, at the annual winter dinner-meeting of the chapter on January 10th at the Fort McPherson Officers' Club.

Capt. Leonard was well qualified to present this subject. He is in charge of one of the largest photographic laboratories in the Third Army area, and has helped to develop the use of still photography in preparing training aids used at both the Southeastern Signal School and the Military Police School. He has also helped to develop the film library at Camp Gordon which is considered one of the most complete of its kind.

W. H. Mansfield, Atlanta Chapter President, was elected Secretary of the Southern Bell Telephone and Telegraph Company on January 1st. Forty years in telephone service, Mr. Mansfield has been Assistant Secretary and Assistant Treasurer, as well as Assistant Vice-President. He will continue to serve as Assistant Treasurer. He is also a director of the Inter-Mountain Telephone Company of Bristol, Va., and of the Carolina Telephone and Telegraph Company of Tarboro, N. C.

Chicago

The Chicago Chapter's January meeting was held at the Automatic Electric Company plant with C. S. Cadwell, president of the firm, acting as host.

C. F. Ffolliot, director of the company's products design section, described "Automatic Toll Ticketing" and K. A. Regel, manager of industrial sales, spoke on "Adventures in Remote Control."

After a short recess the U. S. Navy's color film entitled "To The Shores of Iwo Jima" was shown.

Chapter President Oliver Read presided over the well-attended meeting and introduced the speakers.

Kentucky

The chapter's January dinner-meeting was preceded by an informal get-together at the Lexington Signal Depot Officers' Club.

"Atomic Warfare" was the subject of a talk by Maj. Frank C. Healy, graduate of a course in radiological defense at the Army Chemical Center, Edgewood, Md.

Louisiana

Louisiana Chapter officers are co-operating with officials of local posts of other military associations in sponsoring the fourth annual Industry-Army conference being held in New

RADIO & TELEVISION NEWS

Orleans on February 27th. The chapter will give a luncheon on that day in honor of Maj. Gen. Spencer B. Akin, Chief Signal Officer.

New York

The results of the chapter's annual election are as follows: President—Col. Thompson H. Mitchell, Exec. Vice-President, RCA Communications, Inc.; Vice-Presidents—Lt. Col. Ralph G. Edwards, AT&T Co.; Capt. Roy W. M. Graham, Chief of Staff of Eastern Seafarrier, USN; Col. Peter C. Sandretto, Federal Telecommunication Laboratories; Treasurer—Maj. Theodore N. Pope, Bell Telephone Laboratories; Secretary—Lt. Col. David Talley, IT&T Corp.

Sacramento

Mather Field Air Base was the scene of the chapter's December 5th meeting. Members gathered at the Officers' Club and were welcomed by Brig. Gen. Carl B. McDaniel, Commanding Officer of Mather Field, who gave a resume of the background, history, mission, and training program of the base.

After dinner, the members were taken by bus on a tour of the training facilities of the base. Of special interest was the great quantity of communication and electronic equipment utilized in the training aids.

The program was concluded at the Officers' Club with the motion picture "Guided Missiles." This picture depicted the early experiments, manufacture and launching of the V-1 and V-2 rockets by the Germans during World War II; the improvements and development made by the U. S.; and the relative dependence of guided missiles upon communications and electronics.

Seattle

Radar was discussed by representatives of three varied activities at the December 13th meeting of the chapter in the American Legion Hall.

Commander Dean of the Coast Guard described the radar equipment used by the Coast Guard in performing its duties in wartime and in peace. Some of the subjects he covered were: air search and warning, safety at sea, aids to navigation, radar beacons, enforcement of maritime regulations, ice patrol, protection of life and property at sea, use of balloons and radar equipment in plotting wind directions.

Mr. Hogg of General Electric illustrated his talk with pictures of various types of radar and their uses, ranges covered, technical operations requirements, areas in which certain types are preferred and why. This was followed by a film showing the use of radar in locating enemy craft, homing and navigation in general.

Mr. Kasrow of the CAA concluded the program with a discussion of air traffic control, navigation by instruments, position reports, moving target indicators, identification of planes,

March, 1950

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and the use of radar in avoiding thunderstorms.

South Carolina

The second meeting of the South Carolina Chapter was held in Charleston on December 1st at the U. S. Navy Shipyard. Arrangements for the meeting were made by chapter members on duty at the Shipyard, under the guidance of Capt. R. E. Melling.

Following dinner at the Officers' Club, Capt. Logan McKee of the Naval Shipyard, welcomed the members and guests and gave an interesting account of his experiences during his Naval career. He emphasized the need for associations of special services to promote a better understanding and closer working arrangements between the armed forces and civilian components.

Ralph Grist, Co-ordinator of Military Services for the Southern Bell Telephone and Telegraph Company, then made formal presentation of the chapter charter. He stressed the advantages of the association and the importance of civilian exponents in the development of communications activities applicable to use by the armed forces during time of emergency.

At the close of the meeting, the entire assemblage was conducted on a tour of the Naval Reserve Communications Training Center.

-30-

Square-Wave Clipper

(Continued from page 37)

Low frequency phase shift and response tests are usually made with a 20 to 60 c.p.s. square wave, the exact frequency depending on the low frequency response of the amplifier being checked.

A dip at one point in the square wave, as illustrated in Fig. 3G may be caused by a drop in amplifier gain over a narrow range of frequencies (or at one frequency). If the drop in gain occurs at the square-wave frequency, then the dip spreads over the entire half cycle and we get the condition of Fig. 3F.

Too low a value of coupling condenser, too small a value grid resistor, or a partially open coupling condenser may cause differentiation of the square wave, resulting in a pulsed output signal as shown in Fig. 3H.

The transient response of the amplifier may be checked by noting if there is any overshoot or damped oscillations following the leading edge of a high frequency square wave as shown in Fig. 3I. A damped oscillation of this type may be caused by distributed capacities and lead inductances resonating at a low frequency, causing a sharp rise in amplifier gain at that point. This condition may also be caused by an undamped peaking coil in a video or scope amplifier.

The frequency at which the circuit

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MODEL A-460

TELEVISION FIELD STRENGTH METER

**\$79.50
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Model A-460 is housed in a heavy gauge steel cabinet, battleship grey finish with 6 tubes (standard brands) IN34 Crystal, operating instructions, circuit diagram and guarantee. Weight 25 lbs. 9-10" x 11-10" x 11-10".

Write for 12-page catalogue.

Field Strength Meter; television 12 channel tuner; video IF channel; large 6" directly calibrated meter; hammer tone finished panel; ideal for locating antenna systems; testing transmission lines; testing efficiency of indoor antennas; checking booster efficiency, etc.

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Govt. Cost \$1,800!
7 plug-in Tuning Units
0.2-12.5 mc. except 8C;
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Dyn.; Mounts, Plug-ins.
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Govt. 72 in. Aerial Weather Station! Comes with 14.5 tube, sensitive relay; 2 weather-banking elements. (Twelve use 10, use as receiver: Original package! Wired ready to use!)
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Has DPST green-to-black switch SW 141-1, Plug P1, ea. on 5-ft. 2-cond. & Jack JK-48 on 4-ft. 2-cond. rubber-covered cord. Condition used.
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Frequency response flat over

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(included in the kit are:

1 1/2" folded dipole with horizontal black;

1 1/2" aluminum reflector rods with mounting

1 cross arm with mast clamp attached;

1 five foot aluminum mast (1 1/2" dia.);

1 mast-mounting line spacers;

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RADIO & TELEVISION NEWS

resonates (and at which the peak in response occurs) can be determined by spreading the observed signal on the oscilloscope screen until the individual "cycles" in the damped oscillation can be counted. The number of individual cycles, multiplied by square-wave fundamental frequency, gives the approximate frequency at which the peak occurs. Although the value determined in this manner is not absolutely accurate, it is sufficient for all practical work.

In general, the low frequency characteristics of an amplifier are checked by applying a square-wave signal with a frequency near the lower limit of the amplifier. If the flat top of the square wave is tilted, phase shift occurs. If the leading edge is gradually rounded, there is a gradual falling off in amplifier gain at higher frequencies. If there is a peak or a dip in the signal there is either a peak or a drop (respectively) in amplifier gain at some particular frequency. The frequency at which the peak or drop occurs can be determined approximately by the ratio of the time of the peak or dip with respect to the time for the complete cycle of the square wave.

The high frequency response characteristics of an amplifier are checked in the same manner. For high frequencies, however, in addition to the above mentioned characteristics, transient response can also be checked.

For p.a. amplifiers, square waves at frequencies of 60 c.p.s. and 1000 c.p.s. are normally sufficient. For high fidelity audio amplifiers, frequencies of 20 c.p.s., 200 c.p.s., and 1500 c.p.s. should be employed. Finally, for wide-band amplifiers, additional square waves with frequencies about a decade apart should be used, the highest frequency being about one-tenth the upper frequency limit of the amplifier.

In all cases, however, make sure the scope you are using has a flat enough response to enable you to observe a square wave at the frequency used.

-30-

FARRIS HEADS "REPS"

R. W. FARRIS has been named head R. of "The Representatives" of Radio Parts Manufacturers, Inc. to fill the unexpired term of Leslie M. DeVoe, who asked to be released from further responsibilities this year.

Mr. Farris, a member of the Missouri Valley Chapter, has been active in the affairs of the association for eleven years. Prior to his election as a member of the national Board of Governors, he was president of his chapter for three years.

In addition to naming Mr. Farris, the Board of Governors devoted considerable time at its meeting to an extensive review of national activities, organizational matters, and budget allocations for 1950. They confirmed tentative plans made by the Industry Relations Committee for participation by the organization in the 1950 Parts Distributors Conference and Show, to be held May 22-25 at the Stevens Hotel in Chicago.

-30-

March, 1950



HERE IT IS! A DIRECTION INDICATOR NOW BUILT INTO THE POPULAR NICHOLAS ANTENNA ROTATOR

MODEL \$49⁵⁰
VMO LIST

CHECK THESE
FEATURES...

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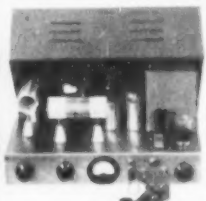
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on any manufactured set. Will
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Handbook 1949 Edition. Will handle 1
K.W.—Completely filtered and shielded.
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(Add 2% to Cover Packing and
Shipping Glass Filter.)

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The most valuable piece of test
and measuring equipment in the
ham's shack would be the grid
dip oscillator. The "Grid Dipper"
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The GDA kit builds an exact dupli-
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includes the special handy case
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instruction book. Complete with
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range 1 mc to 210 mc covered in
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delivers 600 volts to the 5007. Complete... includ-
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40 watts of audio, the MD-40 is a bit of the same
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Off-Frequency Inversion (Continued from page 57)

verter to remove the interfering signal by placing it on the cut-off side of the asymmetrical filter so that only the desired signal and the sideband free of interference, or containing less interference, is heard.

The unit today is an adaptor or accessory. Whenever industry chooses to incorporate this development in receivers, it would eliminate the separate power supply and audio system now provided in the inverter. As an accessory, the receiver audio system is superfluous. If built into a receiver, only two or three, instead of the present nine, tubes would be required because the detector is duplicated and because more amplification is required under present conditions in view of the loose coupling into the receiver. Building it in could save 20 to 30 db. of gain now needed with the method of coupling employed.

The U.S. Coast Guard is the first large-scale user of MCL-4 equipment. As of September 1949, they have procured or ordered sufficient units for 118 radio stations ashore and afloat. In the mobile radio field channel widths are 60 kc. with heavy interference countered up to several channels removed when stations are in close proximity. The MCL-4 signal splitter with its ability to attenuate off-frequency interference approximately 100 db. at 1 1/2 kc. removed from carrier on voice reception, 135 db. down on c.w., and 120 db. down on c.w. audio images shows every promise of making satisfactory communication in channels of narrow width and adjacent channel operations possible. Several channels of communication, without sub-channeling, now become feasible in the bandwidth allocated to single stations today.

From all indications the MCL-4 is one answer to our overcrowded frequency spectrum problem.

REFERENCES

- McLoughlin, J. L. A. "Frit Heterodyne QRM," QST, October, 1947.
- "Selectable Single-Sideband Reception Simplified," QST, April, 1948.



"You'll have to learn to cook your own recipes successfully, Aunt Sophie, we're putting in television!"

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New Improved RCA
Licensed 16"—630 Plus \$1.50 Fed.
Chassis Radio Tuner (Less CRT)

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- Latest type Standard Coil tuner for high sensitivity, UHF adaptation, and easy servicing.
- Full tube complement.

16"—630 Chassis—\$159.95 plus \$1.50 Fed. Excise Tax. (Less CRT)
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All glass 16" C-R Tubes \$79.50

Beautiful cabinets for above—available
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Standard Brand tubes RCA, Sylvania—Nytron			
14B6... 79c	6N7... 89c	12BH7... 59c	
5A2A... 55c	5Y4... 59c	6X6... 69c	
12AX7... 49c	12AU6... 59c	12BH7... 59c	
7AD7... 89c	6X17... 49c	6A4... 49c	
6X4... 69c	6H6... 49c	5Y3... 49c	
6J6... 89c	6AV6... 69c	6AC5... 89c	
6AK5... 89c	6SN7... 69c	12SN7... 69c	
12X5, 6X7... 29c			

Standard Tuning Tuner, complete with tubes	\$26.85
RC-A Horizontal output Transformer 211T5	4.95
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RC-A Deflection Yoke	3.50
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Controls—10 ohms to 25 Megohm W.W. and carbon	
• 1 Meg 1.50c	25c With switch... .29
500 ohm Rectifiers	
75 Ma. 45c	100 Ma. 55c
200 Ma. .79	
Crystal Converters	
1-20 L-71 MLPI	1.25
6 Tube Superhet Kit with tubes	11.95
5 tube Superhet Kit with tubes	10.95
Superhet Variable Condensers	.49
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Automatic Tuners	2.35
Photo-arm Hook-up wire AN connectors, hardware, speakers, antenna loops. Write in for your needs.	
Famous 16" Wired 31 tube 630 chassis, Less CRT	\$174.95

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5 ohm 12 watt, 50 ohm 5 watt, 2500 ohm 12 watt, 11000 ohm 12 watt for BC375 and BC191	ea .17
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For SCR274N and ARCS up to 91"	ea .95
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All equipment brand new and perfect.

LONG ISLAND RADIO CO.
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RADIO & TELEVISION NEWS

TV Troubleshooting

(Continued from page 66)

continue using the signal from the video amplifiers or else use the vertical sweep signal, as outlined previously, for checking the picture i.f. stages. Weak sound in Inter-carrier type sets is sometimes due to misalignment of the picture i.f. stage, thus preventing adequate sound signal to reach the second detector. This can be verified by detuning the local oscillator on the r.f. tuner slightly. If this brings in the sound stronger, possibly at the expense of the picture, then re-alignment is indicated and a suitable generator and v.t.v.m. or scope are needed.

On receivers using separate sound i.f.'s the chance of misalignment in either the sound stage or the trap in the picture i.f. stages is increased. Detuning of the oscillator at the r.f. tuner will usually show if this is the case. Aside from misalignment, the sound i.f. stages can be checked by the same method as outlined previously for the picture i.f.'s, using either the vertical sweep signal or a 60-cycle signal which can be obtained from the power supply.

3. *No picture or weak picture but good sound.* In Inter-carrier type receivers the presence of normal sound indicates that the picture i.f.'s and detector are operating properly. The picture can be lost entirely only in the circuit following the removal of the sound, i.e., in the d.c. restorer, if any, or in the leads or sockets connecting to the picture tube. The audio amplifiers are used as a signal tracer by connecting a .05 μ f. condenser across the volume control and touching the free end first to the plate of the video amplifier from which the sound signal is removed. Then follow the picture signal through all coupling condensers, sockets, etc., until the break is located.

Weak pictures in Inter-carrier type sets are usually accompanied by weak sound and the troubleshooting procedure is the same as in the case for no sound and no picture. If the sound is normal and only the picture is weak, check for an open or shorted peaking coil in the video stages by tracing the picture signal through from the second detector and listening carefully for any loss in volume. In receivers using separate sound i.f. stages, no picture may result from a defect in any of the stages between the point where the sound i.f. is removed and the picture tube. The video amplifier stages are checked by signal tracing when a picture signal can be heard with the free end of the .05 μ f. condenser touched to the second detector load resistor. If nothing is heard the method of signal substitution outlined above is recommended, preferably using the signal from the vertical sweep circuits.

4. *No vertical sweep or very little*

LOWEST PRICE IN TV HISTORY!

Cal-Rad TV CHASSIS

For Sensational New
**16-INCH
RECTANGULAR
TUBE**

Not a Kit!
But a
Completely Wired
Television Receiver

\$129.50

less CR Tube

Chassis Size with Tube: HT. 16" — Depth 16" — Width 18"

3-Knob Control Panel. Station selector, Picture contrast and off, on-volume control. Simple as A. B. C.

Automatic Frequency Control Stabilizing Circuit for locked-in, sharp steady pictures in any location. No tearing out of signal.

Automatic Contrast Control Circuit eliminates fading and flutter.

Automatic Brightness Circuit increases brightness with advanced contrast settings for balanced picture.

Automatic Blanking Circuit eliminates retrace lines.

Vertical Hold Circuit eliminates rolling and jumping of picture regardless of channel, location or interference.

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Wide-Band, High Gain I.F. Amplifier and crystal diode video detector for higher definition and lower noise.

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Engineered Circuits. Standard, long-life highest quality components. Lower power consumption. Approved safety features. Factory engineered, aligned and tested. Standard R.M.A. Guarantee.

Latest 1950 Inter-carrier Sound. Picture and sound automatically synchronized. 18 tubes, including 3 dual tubes, 1 triple tube and 3 rectifier tubes. 1 Germanium crystal diode video detector.

Ready For Your Own Cabinet. Includes chassis, speaker, 5 lucite knobs, clarifier lever, chassis bolts and washers, knob felts, etc.

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With \$4.95
8-Ft. Mast

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March, 1950

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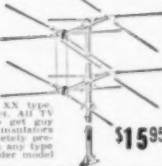
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sweep. Before attempting to troubleshoot a case of no or improper vertical sweep all vertical adjustments should be tried and, if possible, good tubes substituted in the vertical sweep circuit. Then the vertical oscillator is checked by connecting a .05 μfd. condenser to the "high" side of the volume control and touching the free end to the output of the vertical oscillator. If this circuit is functioning properly, a rasping hum should be heard, the pitch of which varies as the vertical hold control is adjusted. The vertical saw-tooth wave can be traced through all components up to the deflection yoke and, in the event that the height of the picture is much too small, the approximate amount of gain in the vertical output amplifier can be estimated aurally.

Touch the probe end of the .05 μfd. condenser first to the grid of the vertical output tube, then to the plate and observe the increase in loudness. If there appears to be no or little difference, this tube is not amplifying properly and a routine voltage and resistance check will quickly locate the guilty component.

To check the operation of the height and vertical linearity control, touch the probe end of the .05 μfd. condenser to the plate pin of the vertical output tube and adjust these controls. The height control should raise the volume of the hum greatly at one setting and reduce it until it is inaudible while changing the pitch only slightly.

The vertical linearity control will also change the amount of hum coming from the speaker but not as much as the height control. To make sure that the deflection yoke and the connections to it are not shorted or open, touch the probe end of the condenser to each of the three vertical terminals located on the yoke. These terminals can easily be exposed by pulling the cardboard collar off the deflection yoke. A defect of this kind is quite rare and in most cases the tracing of the vertical saw-tooth voltage from the oscillator through the output amplifier will suffice to locate the trouble.

5. Loss of vertical or horizontal sync or both. When the picture appears to move up or down and adjustment of the vertical hold control does not keep it steady for more than a moment as in Fig. 4, the most likely source of trouble is in the vertical sync pulse integrator network. This network, shown in Fig. 3, is used almost universally to remove the horizontal sync pulses and permit only the vertical pulses to pass through in form of a sharp pulse every 1/60th of a second. This network consists of a 22,000 ohm and two 8200 ohm resistors in series, bypassed by a .002 and two .005 μfd. condensers. These three condensers are the most likely sources of trouble when only the vertical sync pulses appear to be lost.

A quick and sure method of checking the entire vertical sync system is, again, by means of the .05 μfd. con-

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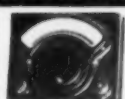
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tomers' home to locate certain types of defects without the use of costly instruments. The skilled service technician will be able to adapt this method to many instances other than those given here, and if you know of some, we would like to hear about them. After using this method for a while, the different sounds from various stages and their defects will become familiar and troubleshooting any of the five symptoms listed here becomes a routine just like checking a 5-tube a.c.-d.c. radio. Although we have shown in this article how some television troubles can be found without any instruments, it should be kept in mind that many other defects cannot be located or remedied without the aid of a v.t.v.m., oscilloscope, and suitable signal generators.

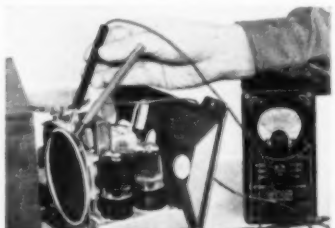
Alignment of the sound and picture I.F. and r.f. stages, as well as the sound F.M. detector, should never be attempted without a good signal generator and v.t.v.m. or a sweep generator and oscilloscope. For good, clear pictures and sound there is no substitute for the somewhat difficult and time-consuming method of alignment as recommended by the manufacturer of the set. For troubleshooting the horizontal sweep and high voltage flyback circuit only the voltmeter and the oscilloscope can help you track down the trouble quickly. The oscilloscope is especially important in the case of non-linearity or poor horizontal synchronism. We want to reiterate that the instrumentless method of troubleshooting as outlined is not proposed as a substitute for using instruments, but as an emergency measure for certain symptoms. It is hoped that this article will stimulate further ideas on using sections of the TV set itself to check other sections, and that it will help to speed up the work of the busy service technician.

CHECK VOICE COIL

A quick check on the speaker voice coil of a radio, when servicing for inoperation, may be made with the small batteries in the service ohmmeter.

It is only necessary to place the two test leads from the ohmmeter across the speaker voice coil terminals. Fig. 1 and listen for a click at the moment of contact which will be forthcoming if the voice coil is Ok H.L.

Fig. 1.



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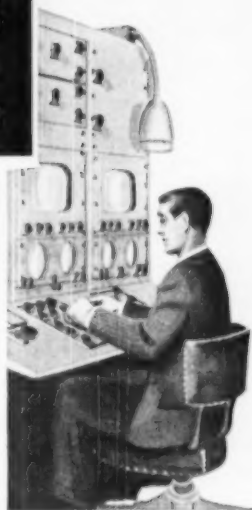
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		VLX3	9.610
(NF)	Brisbane (ABC)	VLQ3	9.690
		VLN	4.917.5
	Sydney (ABC)	VL13	9.500
(I)	(Via Pt. Moreaby-ABC)	VL77	9.530
2255 (NS)	Toronto	CFRX	6.070
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2300	London (GOS)		9.768 A
		OSI	15.280
		GSD	11.750
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		OSB	9.510
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(NS)	Vancouver	CBFX	6.090
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		KWIX	9.570
		RCBA	6.120
2305A	Taipei (Nationalist China, "Voice of Free China")	BED2	11.725
2315			
	Dalhi (AIR-To Central and Sou. Africa)	VUD11	17.780
		VUD5	15.160
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		GSD	11.750
		GRY	9.600
		OSB	9.580
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2330	Edmonton Lake Success (Un-Via Montreal)	CKLX	15.090
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(F and I)	Manila	DZH4	6.000

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ERRATUM

In Fig. 3, page 65 of the January issue the grid connections to the 6SN7 dual-triode phase inverter should be interchanged.

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5 V. @ 115 amp. \$9.95

KENYON 400 ma. 3200 V. No.
center tap. 7.95

ORDER 2 of these Kenyons for 15.00
400-0-400 @ 200 ma. 5V. @ 3 amp.,

6.3 @ 5 amp. 3.95

OUTPUT TRANSFORMER—NEW!
For LM freq. meter. Z-20,000 to

600 ohm .95c

LOW PASS FILTER—NEW!
Flat to 3000 cycles 30 db. down at 3100 cycles. Fine for clipping those sidebands \$4.50

SPECIAL! MOTOROLA CONTROL HEADS!
We just received 200 of 'em. Same kind the cops use. Brand new. \$2.49

KW. POWER SUPPLY
Here's the unit you've been QRX for. 2000 VDC. After filter consists of 2 Kenyon xfrms. 1-2.5V. 10 amp. Fil. Xfrmr 2-600A Tubes and 2 sockets. 2-2 mfd. 400V V. G.E. Cond. Chassis and

Bleeder \$29.50

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Allied SPRT 12 V. \$9c

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METERS! LOOK! METERS!

1' De Jure Sq. \$3.49

0-500 MA \$3.49

0-25 MA DC \$2.79

0-1.5 amp RF \$3.49

200-20 amp DC \$1.75

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S.O.S. BALLOONS!

Ride the March winds! New! \$1.95

TV. IF STRIP
5 1/2" x 1". Contains sockets and all necessary I.F. xfrms all mounted with output xfrmr. and 4 peaking coils. Plus diagram. NEW! \$7.95

JACKSON MULTITESTER
Model 6953-2 DC, miliv. 2, 15, 150, 200, 1500 DC ohms 2000, 200,000. AC Volts 3, 15, 30, 150, 300. DC Volts 3, 15, 30, 150, 300. Large 4" sq. Westinghouse IMA Meter with carrying case. Used but good condition. A hot buy! \$12.50

2 V. WILLARD WET CELL BATTERIES
NO. 20-2, new, boxed \$4.50

Order 2 batts. for only \$1.49

12" COLLAPSIBLE BRASS ANTENNA. \$2.75

Shuts to 1 1/2" Good used cond. \$1.50

W.E. HANDSET, TYPE TS-7 push-button. \$3.50

New

ARC-5 TRANSMITTERS—COMPLETE. Used, excellent condition \$5.95

3-4 mcs. \$2.95

4-5.3 mcs. less cover \$2.95

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SEE HERE! SEE OUR SEA BEAR!

RECEIVER & TRANSMITTER COMBINATION:

BC-312 Receiver. 8 tubes. 15 mcs to 15 mcs. 12V operation speaker or headphones out-put. \$99.50

BC-323A Transmitter. 4-channel crystal controlled 20 mcs. to 15 mcs. Has automatic network for harmonic suppression and max. power output. 4-2 watt per channel. 12V power supply. 12V and 6V. push-button operation. Lens crystals. \$99.50

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COLUMBIA'S HI-POWERED 101 TRANSMITTER. Power output 100 watts. Will really get UN signals thru. Connected to the marine chain. Crystal controlled on 4 diff. freqs. Antenna matching unit. 12 or 14 V. dynamotor, tube, everything made to go. Excel. cond. \$125.00

88-20 HRF RADIO COMPASS RECEIVER. Made by Bendix. Freq. range 150 kcs to 1500 kcs. Complete with 88-20 Receiver. Antenna. 4 x 3 plus. Made in-52 Loop Control Box. Good cond. \$99.90

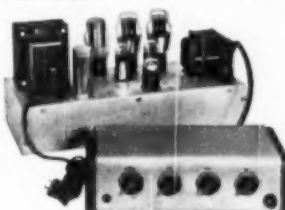
NOTE: Components of any of above units can be purchased separately. Consult us for V.S. marine radio gear. If you need it—COLUMBIA'S got it!

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Add TONE & VOLUME to your TELEVISION with a BROOK High Quality AUDIO AMPLIFIER

ALL TRIODES Attractive small remote control console for maximum convenience in operation and installation

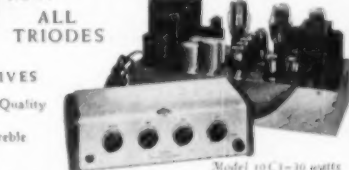


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FOR BEST RESULTS — BROOK GIVES

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G-E 2J1G1 SELSYN
400 cycle Usable 24V
110 VAC Tested, Usable
Guaranteed W. data
3 for \$1

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Amazing \$100 "YAB" Special!
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In Professional Carrying Case, Powerful
Governors Controlled, gear drive GREEN
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78 (adjustable 45 RPM) and 33 1/3 RPM
speeds, 8 inch Sph. PLAS Exceptional
Fidelity Built-In 3-tube 2 to 4 Watt
Amplifier. Used Tested Guaranteed
110 AC or DC. A \$35 Buy! Gra
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INFRARED
 500cye Converter
 Tube Kit Set in Box
 Simplified design
 - dia., with 1/2" dia.
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 up to 350 lines in
 complete data
 Tube, FAM spec.
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TUBES... "TAB" TESTED
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GA V75 S	1.4	2CA2	4644.55.39	6AB2	5.51	6GFS	5	12NR
GA49	1.74	2CA2	4644.55.39	6AB2	5.51	6S7	48	12DGT
GA1	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA2	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA3	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA4	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA5	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA6	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA7	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA8	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA9	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA10	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA11	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA12	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA13	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA14	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA15	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA16	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA17	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA18	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA19	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA20	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA21	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA22	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA23	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA24	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA25	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA26	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA27	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA28	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA29	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA30	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA31	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA32	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA33	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA34	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA35	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA36	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA37	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA38	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA39	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA40	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA41	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA42	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA43	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA44	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA45	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA46	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA47	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA48	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA49	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA50	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA51	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA52	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA53	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA54	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA55	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA56	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA57	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA58	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA59	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA60	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA61	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA62	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA63	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA64	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA65	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA66	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA67	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA68	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA69	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA70	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA71	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA72	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA73	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA74	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA75	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA76	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA77	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA78	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA79	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA80	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA81	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA82	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA83	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA84	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA85	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA86	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA87	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA88	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA89	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA90	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA91	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA92	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA93	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA94	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA95	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA96	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA97	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA98	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA99	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT
GA100	1.74	2CA2	4644.55.39	6AB3	1.09	6SGT	38	12A1GT

35	57	5	47	6018
25	58		53	HY615
15	RR65	24	99	WL619

78	NT08	2.30	AW027
79	701	6.8	701
80	701	6.8	701
81	701	6.8	701
82	CR72	1.17	702A/702B
83	701	6.8	702A
84	NR74	2.0	704A
85	701	6.8	704A
86	701	6.8	704A
87	701	6.8	704A
88	701	6.8	704A
89	701	6.8	704A
90	701	6.8	704A
91	701	6.8	704A
92	701	6.8	704A
93	701	6.8	704A
94	701	6.8	704A
95	701	6.8	704A
96	701	6.8	704A
97	701	6.8	704A
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110	701	6.8	704A
111	701	6.8	704A
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114	701	6.8	704A
115	701	6.8	704A
116	701	6.8	704A
117	701	6.8	704A
118	701	6.8	704A
119	701	6.8	704A
120	701	6.8	704A
121	701	6.8	704A
122	701	6.8	704A
123	701	6.8	704A
124	701	6.8	704A
125	701	6.8	704A
126	701	6.8	704A
127	701	6.8	704A
128	701	6.8	704A
129	701	6.8	704A
130	701	6.8	704A
131	701	6.8	704A
132	701	6.8	704A
133	701	6.8	704A
134	701	6.8	704A
135	701	6.8	704A
136	701	6.8	704A
137	701	6.8	704A
138	701	6.8	704A
139	701	6.8	704A
140	701	6.8	704A
141	701	6.8	704A
142	701	6.8	704A
143	701	6.8	704A
144	701	6.8	704A
145	701	6.8	704A
146	701	6.8	704A
147	701	6.8	704A
148	701	6.8	704A
149	701	6.8	704A
150	701	6.8	704A
151	701	6.8	704A
152	701	6.8	704A
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154	701	6.8	704A
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158	701	6.8	704A
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161	701	6.8	704A
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169	701	6.8	704A
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174	701	6.8	704A
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176	701	6.8	704A
177	701	6.8	704A
178	701	6.8	704A
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180	701	6.8	704A
181	701	6.8	704A
182	701	6.8	704A
183	701	6.8	704A
184	701	6.8	704A
185	701	6.8	704A

19	1619	5.18	K49A	5.38
24	1620	4.95	K55B	16
75	1622	1.75	M55B	39

1624	1.25	LG2A	2.00
1625	1.25	LG2A	2.00
1626	1.25	WL12A	2.61
1627	1.25	WL12A	2.61
1628	1.25	WL12A	2.61
1629	1.25	WL12A	2.61
1630	1.25	WL12A	2.61
1631	1.25	WL12A	2.61
1632	1.25	WL12A	2.61
1633	1.25	WL12A	2.61
1634	1.25	WL12A	2.61
1635	1.25	WL12A	2.61
1636	1.25	WL12A	2.61
1637	1.25	WL12A	2.61
1638	1.25	WL12A	2.61
1639	1.25	WL12A	2.61
1640	1.25	WL12A	2.61
1641	1.25	WL12A	2.61
1642	1.25	WL12A	2.61
1643	1.25	WL12A	2.61
1644	1.25	WL12A	2.61
1645	1.25	WL12A	2.61
1646	1.25	WL12A	2.61
1647	1.25	WL12A	2.61
1648	1.25	WL12A	2.61
1649	1.25	WL12A	2.61
1650	1.25	WL12A	2.61
1651	1.25	WL12A	2.61
1652	1.25	WL12A	2.61
1653	1.25	WL12A	2.61
1654	1.25	WL12A	2.61
1655	1.25	WL12A	2.61
1656	1.25	WL12A	2.61
1657	1.25	WL12A	2.61
1658	1.25	WL12A	2.61
1659	1.25	WL12A	2.61
1660	1.25	WL12A	2.61
1661	1.25	WL12A	2.61
1662	1.25	WL12A	2.61
1663	1.25	WL12A	2.61
1664	1.25	WL12A	2.61
1665	1.25	WL12A	2.61
1666	1.25	WL12A	2.61
1667	1.25	WL12A	2.61
1668	1.25	WL12A	2.61
1669	1.25	WL12A	2.61
1670	1.25	WL12A	2.61
1671	1.25	WL12A	2.61
1672	1.25	WL12A	2.61
1673	1.25	WL12A	2.61
1674	1.25	WL12A	2.61
1675	1.25	WL12A	2.61
1676	1.25	WL12A	2.61
1677	1.25	WL12A	2.61
1678	1.25	WL12A	2.61
1679	1.25	WL12A	2.61
1680	1.25	WL12A	2.61
1681	1.25	WL12A	2.61
1682	1.25	WL12A	2.61
1683	1.25	WL12A	2.61
1684	1.25	WL12A	2.61
1685	1.25	WL12A	2.61
1686	1.25	WL12A	2.61
1687	1.25	WL12A	2.61
1688	1.25	WL12A	2.61
1689	1.25	WL12A	2.61
1690	1.25	WL12A	2.61
1691	1.25	WL12A	2.61
1692	1.25	WL12A	2.61
1693	1.25	WL12A	2.61
1694	1.25	WL12A	2.61
1695	1.25	WL12A	2.61
1696	1.25	WL12A	2.61
1697	1.25	WL12A	2.61
1698	1.25	WL12A	2.61
1699	1.25	WL12A	2.61
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8A34	7	1	G 41.3 1 L NegV	2
8A35	1	1	60 Wk BLRG 4FH	2
8A36	4	2	22.9 W BLRG 1008	8
8A37	1	1	Wkly Taily	3
8A38	1	1	10.5 Wkly Taily	51.4
8A39	1	1	7.3 Wkly FSA100	1.6
8A40	6	1	4.6 Wkly 4GB00	8
8A41	2	4	7.4 Wkly	94
8A51	0.7	1	Wkly MinMax	8
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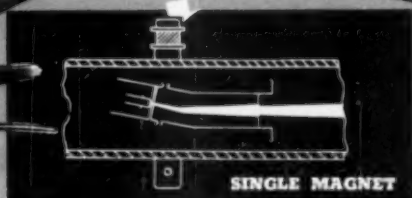


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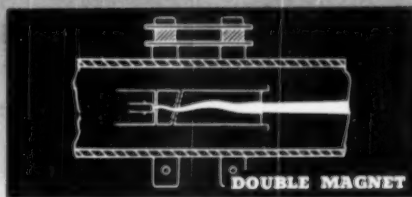
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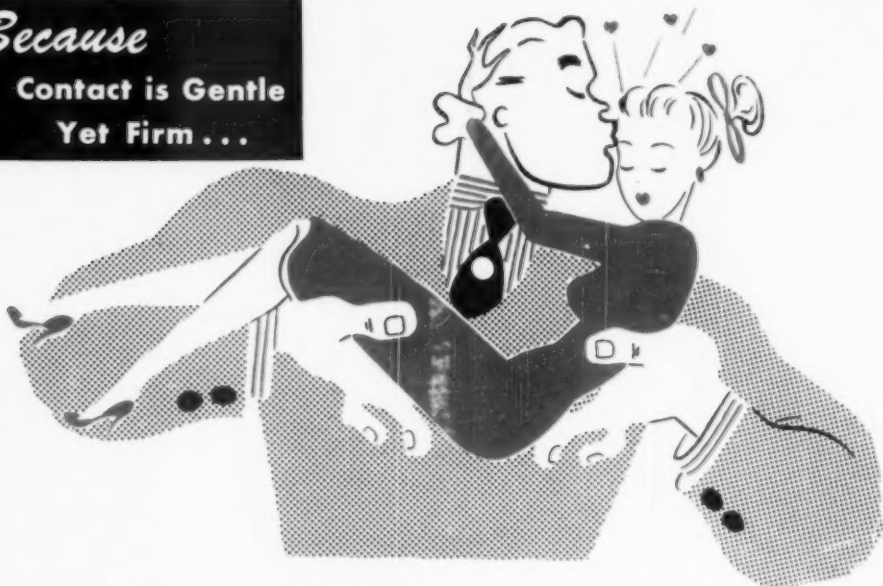
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